DOCUMENT RESUME

ED 401 098 SE 057 336

TITLE	Maine Environmental Priorities Project: Summary of the Reports from the Technical Working Groups to the Steering Committee.
INSTITUTION	National Association for Environmental Education, Miami, Fla.
PUB DATE	Aug 95
NOTE	43p.
AVAILABLE FROM	Maine Environmental Priorities Project, State House Station #17, Augusta, ME 04333.
PUB TYPE	Reports - Research/Technical (143)
EDRS PRICE	MF01/PC02 Plus Postage.
DESCRIPTORS	Agriculture; Air Pollution; Climate Change; *Conservation (Environment); Ecology; Environmental Education; *Natural Resources; Waste Disposal; Water Pollution
IDENTIFIERS	Environmental Action; *Environmental Awareness; *Maine

ABSTRACT

The Maine Environmental Priorities Project (MEPP) is a comparative risk project designed to identify, compare, and rank the most serious environmental problems facing Maine. Once the problems are analyzed and ranked according to their threat or risk to Maine's ecological health, human health, and quality of life, the project will propose environmental protection priorities which take into consideration scientific information and public values. The technical reports included in this document do not contain policy recommendations and there are no proposed courses of action for addressing the identified risks. Rather, they focus on the identification and measurement of risk without regard to the problems associated with possible actions for addressing the risks. These reports were prepared by a group of volunteers having expertise in areas of interest to the project and representing diverse viewpoints. Reports include: Outdoor Air; Global Climate Change; Stratospheric Ozone Depletion; Surface Water and Sediments; Ground Water; Drinking Water at the Tap; Land and Agricultural Resources; Maine's Built and Natural Landscape; Terrestrial Ecosystems; Freshwater and Marine Ecosystems; Indoor Air; Exposure to Toxins in the Work Place; Solid, Special, and Hazardous Waste; and Radiation. (JRH)

****
* Reproductions supplied by EDRS are the best that can be made *
* from the original document. *
****

ED 401 098

Maine Environmental Priorities Project

Summary

of the Reports from the Technical Working Groups to the Steering Committee

August 1995

SE 057 336

PERMISSION TO REPRODUCE AND DISSEMINATE THIS MATERIAL HAS BEEN GRANTED BY

M. T. Mahgrun

TO THE EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)

U.S. DEPARTMENT OF EDUCATION
Office of Educational Research and Improvement
EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)

X This document has been reproduced as received from the person or organization originating it.

☐ Minor changes have been made to improve reproduction quality.

• Points of view or opinions stated in this document do not necessarily represent official OERI position or policy.

Foreword

This document presents general information and selected highlights for each of the issue areas discussed in the document titled "Reports from the Technical Working Groups to the Steering Committee" dated July 1995. It was prepared by project staff and has not been reviewed by the members of the technical working groups.

The reader is encouraged to consult the full report for a thorough review of each of the issue areas. The report can be found in many public libraries across the state.

Indications of level of concern that appear in this summary and in the technical reports reflect the best professional judgment of working group members. They are not final Project conclusions or recommendations. The order in which topics are presented in the report does not reflect issue importance. Rather, closely related topics were grouped to aid the reader.

For more information, please contact the Project at the following address:

Maine Environmental Priorities Project
State House Station #17
Augusta, Maine 04333

Telephone: (207) 287-6843

Table of Contents

Introduction ii

Outdoor Air 1

Global Climate Change 4

Stratospheric Ozone Depletion 5

Surface Water and Sediments 6

Ground Water 9

Drinking Water at the Tap 11

Land and Agricultural Resources 13

Maine's Built and Natural Landscape 17

Terrestrial Ecosystems 19

Freshwater and Marine Ecosystems 22

Indoor Air 25

Exposure to Toxins in the Work Place 27

Solid, Special and Hazardous Waste 29

Radiation 33

Terms and Abbreviations 36

Working Group Members 37

Introduction

The Maine Environmental Priorities Project (MEPP) is a comparative risk project designed to identify, compare and rank the most serious environmental problems facing Maine. Once the problems are analyzed and ranked according to their threat or risk to Maine's ecological health, human health and quality of life, the Project will propose environmental protection priorities which take into consideration scientific information and public values.

Purpose and Scope. One goal of the Project is to look at environmental problems in relation to one another rather than in isolation so that environmental policy may be focused on areas of greatest risk.

By intent, the technical reports do not contain policy recommendations and there are no proposed courses of action for addressing the identified risks. Rather, the reports focus on the identification and measurement of risk without regard to the problems associated with possible actions for addressing the risks. Phase II of the Project will focus on possible ways to address risks. At that time, the technical and social issues associated with possible environmental policy options will be considered.

Issues Areas. The environmental issues studied by the working groups were developed using information obtained from the general public through a survey of over 900 households, focus group meetings, and roundtable discussions. The reader will notice that most of the issues are related to one another as are most of the environmental problems in the real world. An effort was made to minimize overlap between issue areas so as not to count the same risk several times.

Four issues look at pollution of the basic environmental media: Outdoor Air, Surface Water and Sediments, Ground Water, and Land and Agricultural Resources. Two issues look at the impact of air pollution on the functioning of the atmosphere: Global Climate Change and Stratospheric Ozone Depletion. Maine's Built and Natural Landscape looks at the effect of human settlement patterns on our experience of the natural environment. Terrestrial Ecosystems and Freshwater and Marine Ecosystems examine human activities which physically alter or destroy ecosystems. Four issues take a closer look at important ways in which people are exposed to pollution: Drinking Water at the Tap, Food Safety, Indoor Air, and Exposure to Toxins in the Workplace. (The report on Food Safety will be issued at a later date.) Finally, Solid, Special and Hazardous Waste, and Radiation focus on waste streams that are of particular concern to the general public.

Methodology. The reports were prepared by a group of volunteers having expertise in areas of interest to the Project and representing diverse viewpoints. No new research was conducted. Working group members were asked to use existing information and their best professional judgment in their analysis.

Assumptions. The working groups analyzed the "residual risk" from a given problem, that is, the risk that remains given current control programs. The working groups did not speculate about the risks that would be associated with the failure of existing control systems, whether routine or catastrophic. The reader should be aware that if the risk from a problem is currently ranked low, that ranking may be due in part to the success of the current control program.

Limitations. Information on which to base the analysis of risks is limited and varies in quality. The analysis is really a "snapshot" in time using the best information available at the time of the analysis and the best professional judgment of group members. The scope of the task and the time constraints associated with the use of volunteers were limiting factors. However, the technical reports were not intended to answer all of the questions surrounding every environmental issue; rather, the goal was to provide an overview of the issues as they exist at this point in time. The reader is referred to the full report for additional information on the methodology.

Outdoor Air

Air pollutants created in Maine or carried into the state are generated from the burning of fossil and other fuels for energy, transportation and heating. In and out of state industrial processes are also major contributors.

Although much research has been done, there remain many unanswered, pollutant-specific questions related to source, transport, interactions with other pollutants, and impacts. Some of these questions are being explored by scientists, as well as by state and federal regulators.

Ecological Report

Air pollutants of ecological concern covered in this report are:

Ground level ozone (O_3) is not released as a primary pollutant but is formed when hydrocarbons (including volatile organic compounds) and nitrogen oxides react in sunlight. Plant damage from ozone has been documented in areas of the eastern United States, and coastal tree species in Maine have shown signs of ozone injury.

Sulfur oxides (SO_2 and SO_4) are released mainly from the burning of coal and are a major contributor to acid deposition (rain, snow). A small percentage of Maine's high elevation lakes are believed to be susceptible to acid deposition. Emissions are regulated and decreasing. Level of concern is low.

Nitrogen oxides, are formed when nitrogen combines with oxygen at high temperatures. They contribute to ozone formation. They may also cause acid rain. Nitrogen oxides may cause high levels of nitrogen in soils and possible nitrate contamination of ground water. They may also make plants more subject to cold injury and pests. Level of concern is high.

Mercury is released during the burning of coal and solid waste and from some industrial processes. A portion of the mercury released is changed into the most toxic form of the metal, methyl mercury. High concentrations have been found in fish from many of Maine's lakes. Mercury is highly toxic and is known to interfere with reproduction in high level predators such as eagles. Maine is the only area in the U.S. where mercury contamination is thought to have a negative impact on eagle populations. Mercury contamination is widespread. Level of concern is high.

Other Metals. Lead, cadmium, copper, nickel and zinc can enter the air through the burning of fossil fuels and solid waste. Ecosystem impacts from these metals have not been observed. Level of concern is low.

Pesticides. Currently used pesticides break down more quickly and appear to be less toxic than older, out of use pesticides. Problems linked to now-banned pesticides including reproductive problems (egg shell thinning for example) are still being observed. Level of concern is medium.

Polychlorinated Biphenyls (PCBs) were used in a number of industrial processes. They are found throughout the environment. High levels are found at some waste and spill sites. Impacts on wildlife such as reproductive failure have been documented. Level of concern is medium.

Dioxins are by-products of burning and are suspected of being toxic at very low levels. Laboratory studies have shown a variety of reproductive problems in birds and mammals at very low dosages. There is little information on wildlife impacts in nature. Level of concern is high.

Human Health Report

This report examines three categories of pollutants: criteria pollutants which are associated with the burning of fossil fuels and which have historically received the most attention; hazardous air pollutants which include hundreds of substances released from burning and from commercial and industrial processes; and long-lived pollutants which are carried long-distances in the air and deposited in rain, snow, fog, etc.

Criteria pollutants include ground-level ozone, particulate matter, sulfur dioxide, nitrogen dioxide, carbon monoxide and lead. The general public is exposed to all of these pollutants in the air we breathe. Children, pregnant women, elderly and those with health problems such as respiratory diseases are the most susceptible to these pollutants. The major health effects include: difficulty with breathing, lung damage and disease (bronchitis, asthma, pneumonia), damage to the body's ability to fight disease, and increased death rates.

Lead can cause permanent brain and nervous system damage such as retardation and behavioral problems. Except for ozone and particulate matter, amounts of these pollutants in the air in Maine generally do not exceed health standards. Standards are exceeded for ozone periodically, especially during the summer months. The fact that standards are exceeded, the large numbers of people adversely affected, and the potential for long-term lung damage make ozone a high concern. Health standards for particulate matter have been exceeded at three monitoring stations in Maine. Recent studies suggest that current standards are not protective. There is also some evidence that current sulfur dioxide standards are not protective.

Criteria pollutants can interact with one another increasing negative health effects. Trends in emissions of criteria pollutants are relatively stable. Trends for ozone are unknown.

Hazardous air pollutants (HAPs) or air toxics include hundreds of substances. The HAPs examined in the report include: arsenic, asbestos, benzene, carbon tetrachloride, chloroform, chromium, formaldehyde, perchloroethylene, polycyclical organic matter, toluene, xylene, 1,1,1 trichloroethane, and 1,3 butadiene. These chemicals are released into the air whenever any material is burned, for example, from power generation, cars, waste incineration, and space heating. They are also released from industrial and commercial processes such as degreasing operations, vapors from gas stations and dry-cleaning. HAPs can be carried great distances through the atmosphere. Carbon tetrachloride is now present in the air globally at relatively constant levels. Overall, the quality of information on HAPs is poor. Little or no information exists on the health effects of many HAPs; few health standards have been set; and there is little information on levels in the air. The report focuses on a subset of these pollutants which are known to be present in Maine.

The general population of Maine is at risk; however, the elderly and children are at higher risk due to decreased or undeveloped ability of the body to handle these pollutants. Additionally some people are more sensitive to these chemicals than is the general population. Exposures are increased for those who live near emission sources or are also exposed in the workplace. The major health concerns are cancer; birth defects; liver, lung, immune and central nervous system effects; and reproductive effects. Of the HAPs examined in the report, the level of concern for most is high. They are known to cause cancer and, for some, levels in the air in Maine exceed health standards.

Atmospherically deposited persistent airborne pollutants include mercury, insecticides, hexachlorobenzene, PCBs, polycyclical organic matter, dioxins/furans, cadmium, lead and others. These chemicals are carried in the air and deposited on land and in the water through rain, fog, snow and dry deposition. They are found in surface waters and sediments and fish throughout Maine. The amount of contamination from atmospheric deposition as opposed to wastewater discharges or runoff is unknown. However, their presence in remote areas of the state points to an atmospheric component.

These pollutants do not break down readily in the environment. Rather they last for long periods of time and accumulate in fish, meat, and dairy products. Dioxin and related chemicals are among the most persistent chemicals known. The general population is at risk because these pollutants end up in the food we eat. Women of child-bearing age, nursing infants, children and groups with a higher than average consumption of these foods (e.g., sport anglers, Native Americans) are at greatest risk. The health effects of concern include cancer, brain and nerve damage, liver and kidney damage, reproductive and developmental effects, and disruption of the endocrine (hormone) system. The effects of these chemicals may be compounded by one another. Limited data indicate that mercury, dioxin, chlordane, PCBs, DDE and dieldrin concentrations in Maine fish have exceeded health standards for both cancer and non-cancer effects.

Proposed regulations may reduce some releases of dioxin, mercury, lead and cadmium from some sources. In the case of mercury, any decreases may be offset by increases in the burning of fossil fuels. Atmospheric deposition of mercury also appears to be increased by the presence of ozone. Regardless of potential decreases in emissions, the fact that these compounds are extremely persistent means that exposures could continue at current levels for decades. Since humans accumulate these chemicals

in the body and the health effects of one may be compounded by the effects of another means every source of exposure is a serious concern.

Quality of Life Report

The overall level of concern for quality of life impacts associated with outdoor air pollution is rated medium.

Quality of life criteria include:

Aesthetics. Low. Regulations have brought many of the visual and odor problems associated with outdoor air pollution under control. Problems continue near some large point sources. Reduced visibility from air pollution on some days does have a negative effect on quality of life.

Peace of Mind. Medium. Although society has made good progress over the past 25 years in dealing with many of the more obvious problems, outdoor air pollution was often mentioned as a significant concern in the recent MEPP survey. Exposure to pollutants which can cause serious health effects is widespread and the public often does not have good information about the risks.

Recreation. Medium. Outdoor air pollution can decrease enjoyment of outdoor activities. Exhaust from vehicles is a common complaint of bicyclists, joggers and walkers. Decreased visibility on poor air quality days can spoil scenic views. About 113,000 Maine people suffer from respiratory illness during poor air quality events. Their recreational activities are severely limited. The contamination of fish due in part to the atmospheric deposition of mercury, dioxin and other toxic compounds has a negative effect on the enjoyment of recreational fishing in Maine.

Fairness. Medium. Outdoor air pollution exposes all Maine residents to involuntary health risks. The recent controversy over an automobile inspection and maintenance program is complex; however, it suggests that some Maine people feel victimized because they are exposed to pollutants from out-of-state sources. The long-distance transport of some air pollutants means that those who emit the pollutants are not necessarily the same persons who experience the negative effects of those releases.

Sense of Community. Medium. Pollution control strategies which focus on the behavior of individuals can be expected to increase as opportunities for further reductions from large sources decrease. These strategies may prove to be controversial and divisive as in the recent controversies over automobile inspection and maintenance, reformulated gasoline and the trading of air emission credits.

Maine Character. Medium. Maine has a "clean air" tradition. Warnings of unhealthy ozone levels and mercury and dioxin contaminated fish negatively impact our sense of who we are and others' sense of Maine as a relatively clean and pristine state.

Future Generations. Medium. Positive steps have been taken to address many of our air pollution problems; however, contamination of the air on a global scale threatens the ability of the planet to support life.

Economics Positive. There are no direct economic benefits from pollution. Lack of pollution control simply transfers costs from one segment of society to another.

Economics Negative. Medium. Health care costs from air pollution are estimated at $50 million dollars a year in the United States. Air pollution also damages materials including buildings and monuments.

Global Climate Change

This topic examines the risks posed by potential climate changes caused by the build-up of carbon dioxide and other "greenhouse gases" in the atmosphere. It also examines the potential impacts of sea level rise.

Ecological Report

Human activity has released into the air a number of gases, termed greenhouse gases, that have heat absorbing qualities. These gases include carbon dioxide, methane, nitrous oxide and chlorofluorocarbons (CFCs). Many scientists believe increased levels of these gases will cause major changes in the earth's climate. They point to global temperatures that show the 1980s as the warmest decade on average this century and 1990, 1991 and 1994 as the century's three warmest years.

Other scientists, however, are much less confident that the build up of greenhouse gases will have a strong influence on climate. They argue that climate is very complex, highly variable and influenced by many factors. They point out that the earth's climate goes through cycles and the planet may be due for another ice age. Any warming effects may be offset by a long-term cooling trend.

Some models of climate change suggest that in an atmosphere with a heat absorbing capacity equivalent to twice the current level of carbon dioxide, New England's climate could experience increases in both winter and summer average temperatures, increases in winter precipitation and decreases in summer precipitation and soil moisture.

If global warming occurs and if these predictions hold true, the major impacts on Maine ecosystems could include the following:

Forests. Forests could grow more quickly in an atmosphere with more CO_2 and a longer growing season. On the other hand, less summer moisture, heat stress, fewer sunny days and new pest problems could reduce growth. Fire frequency could increase, and forest make-up could change to reflect a more temperate climate (fewer spruce-fir and more hardwood).

Agriculture. The frost free growing season could be lengthened which would increase productivity, if there is available moisture. New pests could thrive in the warmer climate.

Fisheries. Freshwater fisheries may shift from cold water species to cool and warm water species. In the Gulf of Maine, there would be a decrease in the numbers of marine species at the southern end of their ranges.

Sea Level Rise. Warming could increase the rate of sea level rise which could result in coastal erosion, dune and bluff retreat, loss of low-lying coastal lands and marshes, increased sedimentation in harbors and saltwater intrusion into coastal ground water.

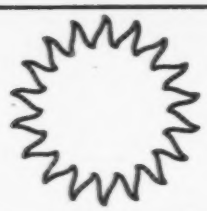
Wetlands. The rate of decomposition in inland wetlands could increase and lead to a net increase of carbon release. Plant communities would shift from wetland species to upland trees and shrubs. Loss of coastal wetlands could change the make-up and reduce the fish populations.

Water Resources. Warmer summer temperatures are likely to increase evapotranspiration (movement of water from soils, plants, etc. into the air), thus decreasing the amount of water reaching the water table, streams and lakes. Changes in peak flow and water chemistry will change wildlife habitats.

Soils. Changes in precipitation and moisture levels could change soil properties increasing the rate of decomposition and changing nutrient balances.

The quality of information is poor. The issue is a high level of concern for research since very little is known and possible problems are great.

There are no reports on Human Health or Quality of Life issues.



Stratospheric Ozone Depletion

The earth's shielding layer of ozone is being destroyed by chemicals which have been released into the earth's atmosphere by human activity. Chlorofluorocarbons (CFCs) have been widely used over the past sixty years as refrigerants, solvents, and aerosol propellants. They are extremely stable. They move into the upper levels of the earth's atmosphere where they break apart naturally occurring ozone molecules in a self-perpetuating chain reaction. Stratospheric ozone plays a critical role in protecting living organisms from excessive exposure to solar ultraviolet radiation. As this ozone layer is thinned, the earth will receive increased radiation from the sun. The increased solar ultraviolet-b (UV-b) radiation reaching the earth's surface will affect ecological systems, human health, and the quality of life.

Thinning of the stratospheric ozone layer was first documented in 1985 when a hole in the ozone layer over Antarctica was discovered. Since that discovery, significant reductions in stratospheric ozone have been documented. Scientists are now working to document the expected increases in solar UV-b radiation reaching the earth's surface. A decade-long UV study in Toronto, Canada showed an increase of 5% per year in UV-b radiation reaching the earth's surface during winter months. Maine has an ozone recording station in Caribou which has been in operation since 1962. A UV-b monitoring station operated by the University of Maine came on line in 1993.

Research has shown that UV-b can damage genetic material, decrease agricultural yields, decrease rates of photosynthesis, and increase certain human health problems. However, the scientific community remains uncertain as to the size of the problem.

Ecological Report

Laboratory studies have shown changes in photosynthesis, nitrogen use, movement and growth of phytoplankton, tiny organisms that form the base of the food chain. It is not known if these problems are occurring in nature. If they are, changes in the population levels of phytoplankton could cause ripple effects throughout the entire marine ecosystem. Species living in the upper levels or shallow areas of aquatic communities will suffer the most from increased UV-b radiation.

There is little scientific data on the effects of increased UV-b on terrestrial ecosystems. Amphibian die-offs in Oregon have been linked to increased UV-b. Studies in Australia link increased UV-b to a decrease in certain commercial crops. Greenhouse studies in the United States show reduced photosynthetic rates from increased UV-b.

Ecological concern is low because of actions which have been taken to reduce or eliminate the production of ozone destroying chemicals.

Human Health Report

Exposure to UV-b causes both cancerous and non-cancerous skin tumors, eye disorders, and cataracts. It also decreases the ability of the body to fight disease.

Quality of Life Report

Maine has an economy based largely on natural resources and access to the outdoors. Anything that affects these aspects of Maine will affect the quality of life here. Even though international agreements now limit uses and production of CFCs, because of their extremely stable structure and long life span, already released CFCs will destroy stratospheric ozone well into the 21st century.

Surface Water and Sediments

This topic examines the effects of chemical pollution of lakes, rivers, wetlands and coastal waters.

Ecological Report

Chemical pollution of lakes, rivers, wetlands, coastal waters and sediments occurs from point and nonpoint sources. Point source discharges come from discrete and identifiable sources, such as wastewater discharge pipes, ships or vehicles. Nonpoint source contaminants enter the environment from widely distributed and more difficult to control sites, such as highways, construction sites and farm fields. Nonpoint sources are cited as the major reason for nonattainment of water quality standards.

Over the past 20 years, wastewater treatment plants have greatly improved water quality in Maine's rivers. Although information exists on bacteria, BOD, nutrients, fish and algae blooms, there is very little information on toxic chemical pollution of surface waters and sediments. Limited testing has found toxic chemicals at levels and in locations that were not expected when testing began. Most of Maine's classified water bodies attain standards set by federal and state laws. However, 423 (1.3%) miles of rives and streams and 284,825 acres of lakes (29.7%) are threatened or do not fully attain these goals. Designated uses are not supported on 124.2 square miles (7.6%) of estuaries. Wetland water quality has not been characterized with respect to contamination.

Contaminants impacting surface waters and sediments are:

Biological Oxygen Demand (BOD). Historically, BOD was Maine's most serious water pollution problem. Wastewater treatment has removed the major, human source of BOD discharge and in doing so has dramatically improved water quality statewide. There remain, however, selected lakes at risk of BOD contamination. The major source of BOD to lakes is development. The major ecological impact is a change to species that can tolerate low oxygen. It speeds up lake eutrophication and causes a shift from cold to warm water fisheries. Major sources of BOD to rivers include wastewater treatment plants, combined sewer overflows, and soil erosion.

Nutrients, primarily phosphorus and nitrogen, from nonpoint sources are often the reason water quality standards are not met. Excessive nutrients cause algal blooms and die-offs of fish and other organisms in marine and freshwaters. They may be associated with the growth of algal mats ("green slime") on intertidal mud flats in eastern Maine. Lakes and estuaries are at highest risk from nutrient contamination. Recent die-offs of shellfish in Maquoit and Saco Bays may be due to nutrients, but no definite cause has been identified. Concern is high for lakes and estuaries from nonpoint sources; medium from point sources to rivers and estuaries.

Petroleum compounds consist of a number of different products with different characteristics. Transportation, storage and use of petroleum products exposes water bodies statewide, but marine waters, because of the large volume of petroleum transported and the potential for catastrophic releases, are at greatest risk. (Eight major oil spills have occurred in the Gulf of Maine since 1963.) At high levels, petroleum can smother or poison fish and waterbirds. Lower levels can cause growth and developmental problems in water life and increase susceptibility to disease. Level of concern low for rivers and lakes; high for estuaries and marine waters.

Pesticides. There is no monitoring for pesticide residues in surface water bodies and sediments. Through air pollution, all surface water bodies are assumed to be exposed to low levels of pesticides. Higher levels are expected to be found in waters nears areas of repeated application. Hexazinone has been found to decrease populations of phytoplankton and zooplankton. Carbaryl has reduced or eliminated some aquatic insects in small streams and ponds.

In addition, older pesticides, such as DDT, continue to present a hazard. Some of the current pesticides are also endocrine disruptors (affect development and

reproduction). Medium concern from agriculture; low from other sources.

Heavy Metals. All surface waters are exposed to trace concentrations of metals in wet and dry atmospheric deposition. Metals are found in the discharges from municipal wastewater systems and industrial discharges which drain into or near inland and coastal waters. Little information other than mercury. High mercury levels detected in fish, eagles and loons are of serious concern as is the fact that elevated metal levels have been recorded in sediments from dredged estuarine materials. Metals can be toxic to aquatic organisms and may affect fish migration in rivers. Concern is high for metals in estuaries and for mercury in fresh waters (lakes and rivers).

Mineral acids are inorganic compounds found in air pollution, acid mine drainage, and manufacturing and agricultural discharges. Marine waters, because of their alkaline nature are not at risk from increased acidification. Small, poorly buffered freshwater lakes are at greatest risk from increased acid inputs. Acidification of headwater streams during spring snow melt and high rainfall events can harm aquatic organisms. Fish reproduction can be affected, but fish population declines have not been documented as a result of acidification. Level of concern is low.

Toxic organic compounds, specifically polyaromatic hydrocarbons (PAHs), dioxins and polychlorinated biphenyls (PCBs) enter water bodies through industrial, municipal and unregulated discharges and through fallout from air pollution. While these compounds have a range of biological effects, and the nature and extent of their impacts on ecosystems are not fully known, there exists a high level of concern regarding their presence in river, estuarine and marine ecosystems.

Chlorine. Chlorine from industrial processes and the disinfection of wastewater from treatment plants is a concern. It is linked to the formation of dioxin. Trace amounts can influence the migration of fish. The impact on Atlantic salmon in Maine is not known.

Human Health Report

Nature and Source of Human Health Exposure. Known health effects of toxic organic chemicals detected in Maine surface waters and sediments include cancer, birth and developmental defects, and disorders of the liver, kidney, lungs, blood, immune and reproductive systems. Pollution of surface waters with toxic chemicals becomes a human health threat mainly from eating contaminated fish or shellfish. Most of these toxic chemicals accumulate and concentrate in living organisms and are highly persistent. Risk increases over time and with additional exposures.

Known Violations of Health Standards. Toxic contamination of surface waters and sediments has only recently been recognized as a critical issue affecting public health and the environment. Currently, persons have been told not to eat the fish from 236 miles of Maine rivers because of dioxin pollution. In the spring of 1994, health advisories were issued for lobster tomalley, again due to dioxin contamination. Since 1994, all lakes in Maine, including those in remote areas, have been under a fish consumption advisory because of mercury contamination.

Extent of Monitoring. Very little is known about toxic chemicals in surface waters and sediments. Only 4% of lake and pond acreage, 3% of river miles, and 0.6% of the square coastal mileage have been monitored for toxic chemicals in any medium (water, sediment, or biota).

There is also little information on the release of toxic chemicals from industries, municipal waste water treatment plants, combined sewer overflows, or other sources. Although chemical-specific testing of industrial and other point source discharges to surface waters is required by the EPA and the Maine DEP under the Clean Water Act, the DEP has concluded that the toxics testing required of these discharges has been inadequate to identify chemicals that may threaten public health as well as aquatic life. In September 1994, new regulations required more testing of industrial and other point source dischargers in the state.

Contaminants of Concern. Based on the limited data currently available, toxic contaminants of highest concern include:

Toxic organic chemicals include dioxins/furans, PCBs, pesticides, herbicides, and fungicides. Reasons for concern include:

- Some twelve toxic chemicals have been detected in Maine fish and shellfish; many of these toxic chemicals are likely to be present as a result of multiple sources, including industrial and municipal point sources (conventional treatment does not remove many of these agents) as well as

dispersed nonpoint sources, presenting the likelihood that contamination is widespread.

- Many of these chemicals bioaccumulate; the present body burden of the average person in the United States is thought by some scientists to be at critical levels for dioxin, one of the few pollutants for which there is adequate data in Maine to determine there is a significant health risk from the ingestion of fish from certain rivers and shellfish from certain locations.

- Many of these agents, including PCBs and several pesticides, herbicides and fungicides are, like dioxin, endocrine-disrupters (disrupt the hormone system and are linked to increased incidence of cancers and disorders of the reproductive organs) and may represent a compounding of risks associated with dioxin, making exposure to any of these a serious concern.

Petroleum. Petroleum, mainly gasoline and fuel oil, is used throughout the state. Spills to surface water do not usually cause a human health problem. Although there are a large number of spills to surface water each year, the likelihood of polluting a drinking water supply above health standards is low. Level of concern is low.

Mercury. Human sources of mercury contamination in surface waters and sediments in Maine include air pollution from the burning of fossil fuels and medical wastes; nonpoint source runoff; and industrial and municipal waste discharges. Inorganic mercury is converted to organic forms in lakes, rivers and other water bodies. Methylmercury is mobile and builds up in aquatic organisms, including fish. Concern over mercury contamination is based on:

- Exposure of potentially significant numbers of people (people who eat fish, especially freshwater fish caught in Maine) to levels above those that cause health effects.

- Severity of potential health effects: mercury causes neurological damage, particularly in fetuses and infants, and is also an endocrine-disrupter, which may produce compound effects with other chemicals (see above). Pregnant women, nursing mothers, women who may become pregnant and children less than 8 years of age have been told not to eat fish from Maine lakes and ponds.

- Increasing levels even in remote areas indicate a widespread and growing problem.

- The persistence and tendency of mercury to bioaccumulate. Level of concern is high.

There is no report on Quality of Life issues.

Ground Water

Maine has limited ground water resources due to a high rainfall (average of 42 inches per year or 66,600 million gallons per day), a geology that favors runoff over infiltration (shallow soils and bedrock and relatively few sand and gravel deposits), and more than 2900 lakes which provide water storage.

In 1990, ground water made up only 16% of Maine's water uses; however, it made up almost half of all household water use. Ground water is also an important source of water for agricultural, commercial and industrial operations. Ground water is withdrawn from two basic types of aquifers: sand and gravel and fractured bedrock. The largest ground water withdrawals occur in Cumberland and York Counties (about 44%) where there are major sand and gravel aquifers and high demand. Ground water is linked to surface waters with almost all ground water in Maine discharging to a surface water body.

Ecological Report

Pollution of ground water is a concern for ecological systems primarily when the ground water discharges to surface waters. Nutrient contamination of ground water was examined in the ecological report.

Nutrients aide plant growth. They include phosphate, nitrite/nitrate and ammonia. Of these, nitrates and nitrites are the most important because of the amount of known contamination and their high mobility in ground water. Nitrogen is a primary nutrient required by both algae and rooted plants. Phosphorus binds readily with soil particles and is not expected to travel great distances in ground water. It may be of concern in circumstances where the distance between the source of contamination and the discharge point to surface water is short or in other cases where the contact time with soil particles is short (rapid entry into bedrock aquifers). Ammonia may be changed to nitrate.

Major sources of ground water nutrient contamination include: agriculture (fertilizer and manure), wastewater discharges (septic systems, underground injection, spray irrigation), and solid waste including land application of sludge. Other sources may include atmospheric fallout and the breakdown of organic matter.

There are about 200,000 acres of cropland and 500,000 acres of pasture land in Maine that may receive fertilizer applications. There are no estimates on the amount of ground water that may be contaminated from agricultural practices; however, some studies have been conducted. One found that 21% of the wells in cropland areas exceeded the drinking water standard for nitrate of 10 parts per million nitrogen (30-100 times the typical level of nitrogen found in surface waters). Since agricultural activities are not evenly distributed about the state, the size of the problem is regionally variable.

Wastewater discharges from septic systems are probably the most widespread source of nutrient contamination of ground water. In 1990, there were more than 301,000 septic systems in Maine. The typical nitrate concentration reaching ground water from septic systems is 30 to 40 parts per million nitrogen.

Eutrophication (aging) of surface water is the main ecological concern. Toxic effects from ammonia may also occur. The amount of surface water harmed by nutrient contamination from ground water is not known but is significant in some cases. Trends on nutrient loading to ground water are unknown.

Human Health Report

Ground water contaminants discussed in this section include: petroleum products, chemicals subject to accidental spills especially chlorinated solvents (dense non-aqueous phase liquids or DNAPLS), pesticides and arsenic. Contamination of ground water from land application of sludge and residuals is discussed in Land and Agricultural Resources; contamination from the improper disposal of wastes is discussed in Solid, Special and Hazardous Waste.

Petroleum Products. There are 38,000 registered underground petroleum storage tanks in Maine and 320,000 aboveground residential oil storage tanks. There are also a growing number of aboveground

gasoline storage tanks. Contamination of ground water by leaking underground tanks is the most common, but spills from aboveground tanks can also occur. About 75% of Maine's population heats with fuel oil. Many of these individual tanks are often located near the homeowner's water well and they are responsible for contamination of a significant number of wells. Contamination from highway spills is not common because most of the spills are cleaned up quickly. Ground water contamination from leaking gasoline tanks has been found at levels from 50 parts per billion to more than 300,000 parts per billion (Town of Friendship). An average of 70 wells per year have been polluted since 1988. The full extent of ground water pollution is not known because spills are not obvious until found in a water well.

Petroleum is made up of more than 230 individual chemical compounds. One component, benzene, is known to cause cancer in humans. Another, benzo-a-pyrene is thought to cause cancer. Some components are known to cause liver, kidney and nerve damage; however, very little is known about the health effects of the other compounds in petroleum. Petroleum can last in ground water for long periods of time. Movement of ground water continues to spread contamination. Once polluted, a ground water supply is very difficult to clean to the point where the water is again safe to drink. MTBE, a gasoline additive, is an extremely common contaminant of ground water in the area of any gasoline tank, even where there have not been substantial leaks. The health effects of MTBE are not well known, but it does not appear to cause cancer.

Level of concern for petroleum is high because of the number of possible sources of contamination, its toxicity and persistence, the inability to clean water to drinking water standards, and major unknowns regarding health effects.

Toxic Organics other than Petroleum or Pesticides. Although handling of chemicals and reporting and response to spills has improved, periodic spills from regular chemical use remain an important concern. Department of Environmental Protection spill report records show over 2100 spills occurred between 1988 and 1993, an average of 350 per year. Major contaminants of concern include solvents: trichloroethylene, tetrachloroethylene, 1,1,1 trichloroethane, trans 1,2 dichloroethene and 1,1 dichloroethene. Of these only trichloroethylene is thought to cause cancer in humans. Other health effects include nervous system damage and irregular heartbeat from short-term exposures and liver and kidney damage from long-term exposures. These chemicals, which are heavier than water, are extremely persistent in ground water and are almost impossible to clean up. Cleanup using current technologies can take more than 100 years; therefore, they effectively render ground water unfit for human consumption. Level of concern is high.

Pesticides. Little is known about pesticide contamination of ground water wells in Maine; however, some studies have been conducted. These studies suggest that pesticides are contaminating ground water, although the level of contamination is generally below health guidelines for drinking water. One study found aldicarb in 47% of the wells tested from locations near sites of aldicarb use. Another concluded that bedrock wells overlain by till in potato growing regions of the state are most likely to be polluted by agricultural pesticides. A 1994 study of hexazinone (velpar) pollution of wells found contamination in 71% of the wells tested, although information on the number with contamination exceeding health standards was not available at the time of this report. To date five pesticides have been found in well water at or above health standards: alachlor, aldicarb (temik), atrazine, diazinon and dinoseb. Of these alachlor, aldicarb and atrazine are suspected of disrupting human hormone function. Level of concern is medium.

Arsenic. Arsenic is a naturally occurring element, but there are also significant human sources of arsenic to the environment including copper and lead smelters, wood preservative manufacture and use, historic pesticide manufacture and use, occupational uses, home products and waste sites. In Maine, most of the arsenic is thought to come from natural sources. In 1994 the Maine Geological Survey analyzed 4700 drinking water sources for arsenic. 444 samples or 11.5% were found to exceed the drinking water standard of 50 parts per billion. Some forms of arsenic cause cancer of the liver, bladder, and kidney in humans. Long-term exposure is associated with skin changes, heart damage, hearing loss, reduced resistance to infection, and other health effects. The elderly and the young are at special risk. Level of concern is medium.

There is no report on Quality of Life issues.

Drinking Water at the Tap

This report should be read along with the section on ground water. It describes what is known about pollution of sources of water (ground water and surface water). It also reviews the effects of water treatment processes such as chlorination and of pollution such as lead and asbestos from the distribution system.

Human Health Report

In Maine, about 540,000 people obtain their drinking water from private supplies, primarily individual ground water wells. About 689,000 people are served by public water supplies which are mainly derived from surface waters such as Sebago Lake. There are no testing or monitoring requirements for self-supplied systems. As a result, little is known about the quality of private wells other than the information obtained through specific studies such as those which have been done for arsenic, radon and pesticides. On the other hand, public supplies (15 service connections or at least 25 individuals daily for more than 60 days per year) are required to check for specific pollutants. Testing requirements vary with the type and size of the supply. Programs to protect water supplies include: the Drinking Water Program administered by the Department of Human Services; the wellhead protection program, a voluntary program which examines possible sources of contamination near the wellhead; and the well driller certification program administered by the Department of Human Services, which is designed to make sure that wells are drilled, constructed, altered and abandoned in a way that protects ground water from contamination.

Private Supplies, Primarily Ground Water Wells. The overall level of concern for private wells is high. Possible problems include:

Radioactivity. About 10% of private drinking water wells in Maine (about 25,000 people served) have levels of radioactivity from uranium which exceed proposed health standards.

Arsenic. In a Maine Geological Survey study of 4,700 water supplies, about 11.5% of the samples had levels of arsenic greater than the health standard of 50 parts per billion. The highest levels were found in bedrock wells.

Accidental Chemical Spills. From 1988 to 1993 15 wells were polluted and 73 wells were threatened by accidental spills of hazardous chemicals.

Petroleum Spills. An average of 70 wells per year have been polluted by petroleum spills since 1988.

Pesticides. Maine studies show that pesticides are polluting ground water, but generally at levels below health standards for drinking water. Wells located within a quarter of a mile of agricultural or forest spray areas are the most likely to be polluted.

Waste Disposal Sites. There is little information on ground water wells polluted by solid waste disposal sites. Hazardous waste sites have threatened or polluted about 200 residential wells.

Bacteria and Viruses. Most bacteria attach to soil particles and do not move far in ground water. They can be a problem for shallow wells in sand and gravel aquifers or if wells and septic systems are improperly located. Little is known about the movement of viruses in ground water. [The report does not discuss bacteria and viruses in surface water supplies.]

Nitrates and Nitrites. These compounds may leach from fertilizers and manure applied to land, and from septic systems. They are very mobile in ground water. Pregnant women and infants are the most at risk. The major health effect is a blood disorder in infants. Well data from the Department of Human Services showed that 1.9% of 5,340 wells tested (or 100 wells) had more than the standard of 10 parts per million nitrogen.

Asbestos and Lead. Asbestos is known to occur naturally. A check of 87 community water systems in Maine with wells located in asbestos bearing rock did not find a problem; therefore, it is not thought to be a problem for private supplies. Lead solder used in plumbing systems may be a problem for some private supplies, but there is no information on the size of the problem.

Public Water Supplies. The level of concern for public supplies is medium. Pollutants of concern are discussed below. Of these, petroleum products and chlorinated organics are present due to contamination of water at the source (lakes, rivers, ground water). Arsenic is naturally occurring and may therefore be present at the source. Lead and asbestos are generally thought to come from plumbing. Chlorination by-products are formed in the distribution system as the result of adding chlorine to surface waters with high natural organic content. Numbers used in this report are only general indicators of pollution. It was not possible to determine the extent to which more than one sample from the same source was included in the data sets.

Chlorination By-products. Disinfection of surface water supplies is needed to kill germs and prevent infectious diseases. Chlorination, the most common form of disinfection, can produce a class of compounds known as trihalomethanes (THMs) through the interaction of chlorine with naturally occurring organics such as the breakdown products of dead leaves. Studies have shown an increased cancer (especially rectal and bladder cancer) risk in humans associated with chlorinated water with bladder cancer mortality 22% higher, bladder cancer incidence 24% higher, and rectal cancer incidence 38% higher in populations drinking chlorinated water. Due to the effectiveness of chlorination in preventing waterborne diseases, the acceptable level (100 micrograms per liter or parts per billion) has been set at an excess lifetime cancer risk of 1.74 in 10,000. At present, public supplies serving fewer than 10,000 people are not required to monitor for THMs. These small systems are of special concern because regular monitoring is not performed and levels of THMs have exceeded safe levels in some cases. Due in part to concerns over chlorination by-products, some public supplies are turning to other disinfection techniques such as ozonation (e.g., Portland Water District).

Lead. Between 1989 and 1994, from 2% to 12% of the public water supply tests in Maine violated the health standard for lead. Although lead may occur naturally, the main cause of lead in water supplies is thought to be the distribution system (pipes and solder). Exposure to lead via drinking water can be large (EPA estimates 10% to 20% of a child's lead intake). Lead is of special concern for children below the age of 6 because it can cause learning and behavioral problems.

Asbestos. Although asbestos may occur naturally, asbestos cement pipe has been used in water distribution systems in Maine. It can pose a health threat if asbestos fibers are shed into the water. Asbestos has been linked with benign (non-cancerous) tumors in laboratory animals. All community water systems (general public) and non-transient, non-community (for example, a school with its own) are required to test for asbestos by the end of 1995. As of February 1995, test results from 185 of Maine's 400 community water systems did not show a problem.

Arsenic. Arsenic may be present in ground water supplies because it is common in nature or as a result of human activity. Between 1989 and 1994 from 1 to 6.4% of tests from public water supplies showed arsenic levels greater than health standards. Most is thought to be naturally occurring.

Petroleum Products. Gasoline, fuel oil and MTBE have been found in public water supplies in Maine.

Chlorinated Solvents. Chlorinated solvents, dense non-aqueous phase liquids (DNAPLS), have also been found in public water supplies.

There are no reports on Ecological or Quality of Life issues.

Land and Agricultural Resources

This topic discusses the ecological and human health effects of contamination of soils. It also examines the loss of farms and farmland as a result of development or erosion.

Ecological Report

While generally described as acidic and thin, there are 100 different types of soils in Maine. They have a range of characteristics that are considered when making land use decisions. The important role of soil and soil organisms in sustaining Maine's landscape is recognized. However, no assessment has been made on the health of the state's soil resources.

Pesticides. Widespread use of pesticides began in the 1940s. State and federal laws regulate the roughly 600 pesticides currently available for use or sale in Maine. The Maine Board of Pesticide Control tracks the amount of pesticides purchased and used each year by commercial applicators. In 1993 agriculture was the major user (about 89% by active ingredient). Forestry was second at almost 11%. Pesticides are also applied on roadsides, rights-of-way and lawns. Impacts from past uses of pesticides, particularly DDT, raised public and scientific awareness about the ecological threats and the dangers of persistent pesticides.

Most pesticides licensed for use today are not persistent. They break down quickly in the environment. Older, more persistent ones, while no longer being sold, are still being found in the environment. As little as 1% of the active ingredient of pesticides may reach the target organism (insect pest or weed). The remaining chemicals enter the ecosystem through a variety of pathways, but little is known about what happens to them.

Pesticides, when used to remove competing vegetation, can contribute to soil erosion by killing protective ground cover. There is some concern over the possibility of such effects on Maine's blueberry barrens.

The level of concern for the current use of pesticides on soils is low because newer pesticides are generally less toxic and they break down quickly in the environment. However, there is little information on the actual impacts of pesticides on soil ecology.

Sludge and Residuals. A number of organic wastes produced in Maine, including food and fish wastes, wood ash, sludge from municipal and pulp and paper wastewater treatment plant facilities and lime-mud, are being composted and/or directly applied to land. These wastes can provide soils with nutrients and organic matter. At the same time, disease causing organisms, metals, excessive nutrients and dioxins, furans and other organic chlorides are potential problems. Land application of sludge and residuals is regulated by the Maine DEP to minimize negative effects from these pollutants. Limited monitoring data in Maine has not uncovered ground water degradation or plant uptake of contaminants. It is possible that more extensive monitoring would detect more impacts. The level of concern is low.

Air Pollution. Nitrogen, sulfur and heavy metals are washed out of the air by rain, snow, and fog or may be deposited as dust. These pollutant are probably having an impact on Maine soils. Nitrogen, if deposited at high enough levels on sensitive sites, may begin to move from soils into ground water. Both nitrogen and sulfur are believed to make soils more acidic. Elevated levels of metals are found in Maine soils; however, the levels are not believed to cause a problem in most cases. Mercury is the only metal of high concern. Nitrogen is a high concern because of the potential impacts on nutrient cycling, soil acidity and nitrogen saturation of soils. There is no good information on ecosystem level impacts.

Human Health Report

Pollution of land can cause human health problems. Pollutants include:

Lead. The level of concern for lead is high. Direct releases of lead to soil occur from air pollution (the widespread use of unleaded gasoline has decreased

this source significantly), peeling and flaking lead-based paint, industrial processes and waste disposal. Lead tends to stick to organic matter in soils. Most of the lead is retained in the top 1 to 2 inches of soil where it can remain for many years. As a result extremely high levels (30 to 2,000 parts per million) have been found in soils next to roads and buildings with peeling and flaking lead-based paint. In Maine, 54% of soil samples taken near housing built before 1950 had lead levels higher than 1,000 parts per million.

Children below the age of 6 are the most sensitive to lead exposure because of their developing nervous systems. In addition, the developing fetus is highly susceptible to lead in the mother's body. Health effects include attention deficits, behavioral problems, decreased intelligence, and brain damage. The 100,000 Maine children at or below the age of 5 are all considered to be at risk. In 1994, lead poisoning was confirmed in 115 Maine children . Lead lasts a very long time in the environment and builds up in blood, bone and tissue of living things. Although lead is no longer used in paint and gasoline is unleaded, lead will continue to be a potential health risk for children for the foreseeable future.

Dioxin. Level of concern is medium. Dioxin is a common contaminant of certain solid wastes such as pulp and paper mill waste, textile mill waste, tannery wastes and wastewater treatment plant sludge. Other sources of dioxin to land include air pollution from waste incineration, historic use of gasoline and certain pesticides. In 1993 analysis of sludge from Maine's wastewater treatment plants found dioxin at levels from undetectable to 1194 parts per trillion. Land application of sludge is regulated by the Department of Environmental Protection. Sludge containing dioxin levels of greater than 27 parts per trillion (ppt) are managed to control the potential for human exposure and movement off the site where it was applied. In practice, wastewater treatment plants are not land applying sludge with greater than 27 ppt dioxin and paper mills have voluntarily limited their application of such sludge. The application of sludge with less than 27 parts per trillion dioxin to agricultural land is allowed but is still of concern from a health viewpoint. Although plant uptake of dioxin is very low, there is the risk of eating dioxin in dirt which sticks to the crops. Dioxin-contaminated soils may be washed into surface waters where it will accumulate in fish. Application of sludge is regulated to control erosion and runoff.

Dioxin causes cancer in humans. Other effects include disorders of the hormone system, reproductive system, kidneys and liver. Given the current levels of dioxin that all of us carry in our bodies, any exposure is of concern. Women of childbearing age are a special concern because of the increased risk to developing babies.

Polychlorinated Biphenyls (PCBs). Level of concern is medium. PCBs are found in industrial and municipal wastewater treatment plant sludge. They also pollute land as a result of spills from electrical equipment, waste sites, improper waste oil disposal, and air pollution from burning of PCB containing wastes. The most likely route of human exposure is erosion of PCB contaminated soils into surface waters where it builds up in fish which are then eaten. PCBs are believed to cause cancer in humans. They also interfere with reproduction and development and our ability to fight disease. Manufacture of PCBs was stopped in 1977. They continue to be a problem because some are still in use, they last for a very long time in the environment, and they accumulate in living things.

Pesticides. Level of concern is medium. The pesticides of greatest concern are those which are currently being used in Maine and which are known to disrupt human hormone (endocrine) systems. These include atrazine, endosulfan, carbaryl, 2,4-D and benomyl. In addition pesticides that have been banned or restricted in the United States may be carried into the U.S. by air pollution (for example, DDT, dieldrin and lindane). For the general population, exposure to these chemicals from soils is limited although these exposures may be made worse by additional exposures from polluted drinking water and fish. Groups of people of particular concern are farm families, farm workers and their children. These populations are discussed in the section on Worker Exposure to Toxins. Persistence of many of the older pesticides means that they will continue to present health risks for years to decades after use has stopped.

Petroleum Compounds. Level of concern is medium. The possibility for spills of petroleum is great: there are 38,000 registered underground storage tanks and more than 320,000 aboveground residential storage tanks in Maine. There are also some very large aboveground tanks up to 11,000,000 gallons in size. Between 1988 and 1993 there were an average of 1930 spills per year from storage tanks. Humans may be exposed to contaminated soils through eating, contact with the skin, or breathing of vapors. Vapors in confined spaces such as basements, utility conduits or trenches are of greatest concern. Very little is known about the health effects of the 230 components of petroleum, although

benzene is known to cause cancer in humans. In addition to toxic effects, there is the real damage of explosion from spills and accumulation of vapors in confined spaces. Sandy soils may clean up through natural processes in 5 to 10 years, clay rich or silty soils require decades. Spills may increase in the future as the number of aboveground tanks which are less regulated increases.

Arsenic. Level of concern is low. Potential human causes of arsenic in soils include use of pesticides, disposal of wastes, certain industrial processes, air pollution from the burning of fossil fuels, and land application of sewage sludge. Although arsenic has historically been a major ingredient in some pesticides, arsenic containing pesticides are no longer sold in commercial amounts in Maine for use on crops. Only one facility in Maine (a wood preserver) reported arsenic releases to land in 1993. Ingestion of soils in not likely to occur at a level that would cause significant health effects. Releases are decreasing.

Heavy Metals other than Lead and Arsenic. Level of concern is low. Pesticides, waste sites, land application of sludge and residuals, and air pollution all add to metal contamination of land. Potential metals of concern include aluminum, cadmium, copper, nickel and zinc. Of these, only zinc accumulates in plant tissues. Current regulation of pesticides and land application of sludge and other wastes should avoid build-up in soils.

Quality of Life Report

The Quality of Life report examines the problems of loss of farms and farmland due to abandonment and development and the loss of soil to erosion.

Background. There are about 5 million acres of prime agricultural soils in Maine (29% of the land area), 1 million of these are currently being used for farming purposes. This number is down from a high of 6 million acres in 1880. In 1992 there were 5,776 farms in Maine, down 18% from 1982. During this period the number of dairy farms declined 54% from 1,784 to 836; poultry farms, 49% from 145 to 74; and potato farms down 32% from 1,134 to 770. Total farm acreage fell only 14% indicating a move to fewer but larger farms.

Loss of Farmland Due to Abandonment or Development. About half of Maine's farmland is located in the Interstate 95 corridor, and 55% of good farmland soils are located in Cumberland County. Before 1950, almost all abandoned farmland reverted to forests. During the past 40 years, some of the abandoned farmland has been converted to residential or commercial development, particularly in the southern part of the state. From 1960 to 1980 southern Maine counties lost farmland to development at twice the state average. During this period, 67% of all housing and commercial development was built on prime agricultural soils. Through a cumulative process of abandonment and development, much prime farmland is being permanently lost to Maine. There is the danger that a critical number of farms will be lost, industries serving agriculture will be lost, and agriculture will no longer be a viable industry.

One cause of farmland loss is the low profitability of farming. In 1980 15% of Maine farmers lost money and only 5% made more than $25,000. The poverty rate for farm families was two and one-half times that of other Maine workers. Causes include: climate, falling food prices, prices set by national and global markets, lack of coordination of government programs, regulations and taxes. Some argue that the industrialization of agriculture (heavy reliance upon non-farm inputs such as pesticides, marketing, etc.) is, at least in part, responsible for financial losses. They urge the use of more sustainable practices.

Land values and development pressure are also responsible for the loss of farms. High land values and high taxes create an incentive to sell. Development pressure comes from a sharp increase in housing demand in part due to smaller household sizes. During the period from 1960 to 1980 for every five new people in Maine, four new homes were built. There has also been an increased interest in rural living. From 1940 to 1980 two-thirds of all housing growth took place in rural areas.

Loss of farmland to abandonment and development means fewer working farms, the loss of open space, and the loss of one part of Maine's character. Loss of farms and loss of prime farmland to development is expected to continue.

Farmland Loss Due to Erosion. Erosion is the removal of topsoil by wind, rain and snow melt from farm fields to other areas, usually nearby streams and lakes. Erosion is a natural process that becomes a problem when the rate of loss is greater than the rate of soil formation. Soil erosion decreases productivity, harms the environment, and costs money. The economic loss from soil erosion in Maine was estimated at $10.7 million in 1982. Soil erosion is lessening in Maine in part due to the use by farmers of best management practices. Erosion rates

on cropland in Maine have been reduced from nearly 2 tons per acre in 1982 to 1.3 tons per acre in 1992. Soil erosion is currently a problem on only 1.5% of Maine farmland.

Quality of Life Criteria. The loss of productive farms and farmlands is of high concern. It has the following impacts on quality of life in Maine:

Aesthetics. High impact. Farms provide open space, access to views, and pleasing historic sights. Their loss is often irrecoverable.

Peace of Mind. Medium impact. The presence of farms provides a reassuring connection to Maine's history, identity and sense of place. They also provide food security.

Recreation. Medium impact. Farmers have traditionally allowed access to their land for hiking, hunting, cross-country skiing and snowmobiling. They also provide habitat for wildlife such as deer.

Fairness. Medium impact. The loss of farms greatly affects farmers and businesses dependent upon agriculture. Their way of life is disappearing.

Sense of Community. High impact. In addition to their value to farmers, farms are a community resource providing opportunities for children to learn about nature, how food is produced, etc.

Maine Character. High impact. Farms are an important part of Maine's traditional way of life. Communication of a work ethic, appreciation of nature, maintenance of a relationship between the natural world and the human community are part of Maine's identity.

Future Generations. High impact. The loss of farms and productive farmland is a loss to future generations who will no longer have access to farm resources or farm experiences. It is also contributing to a loss of future generations. Maine's largest agricultural counties are also those counties where young people say that they are most likely to move away from Maine: 28% of Waldo County residents and 18% of Aroostook County compared with 9% statewide in a 1988 survey.

Economics. Medium impact. In 1992 an estimated 62,100 jobs were directly dependent upon farming in Maine. In addition, a large sector of the economy relies on agriculture for a significant portion of their business (for example, trucking, laboratories, warehouses).

Maine's Built and Natural Landscape

This topic addresses the threat to Maine's cities, towns, countryside and wilderness from the pattern of human settlement also known as "sprawl," "suburbanization," or "homogenization" of the landscape. The discussion is divided into four sub-topics: deterioration of downtowns, loss of character of town centers, loss of rural character, and loss of wildlands.

Quality of Life Report

Deterioration of Downtowns. The number of people per unit of area (density) in Maine's city centers is less than half what it was immediately prior to World War II, the peak of urban living in Maine. Between 1950 and 1970, the population on the Portland peninsula fell from 43 to 27 persons per acre with most of the people moving to the surrounding towns including Cape Elizabeth, Falmouth and more distant suburbs. In 1950 the Portland Metropolitan Statistical Area included Portland, South Portland, Westbrook, Cape Elizabeth and Falmouth. It now extends to Freeport, Casco, Limington and Old Orchard Beach. Similarly the Bangor Metropolitan Statistical Area now includes 14 municipalities. The people remaining in the city centers tend to be the poor, elderly, young and disabled. With the departure of middle class working families, businesses soon followed leaving a trail of abandoned buildings in their wake. Some Maine cities have attempted to counter this trend; however, the downtowns of most major Maine cities appear to have lost their vitality. Impacts of sprawl include: loss of commercial-retail establishments to malls, abandoned buildings, working waterfront space changed to other uses, social segregation, streets serve as transportation corridors only.

Loss of Character of Town Centers. The typical historic New England town is characterized by a compact town center surrounded by farms and forests. The town center consists of a green or common surrounded by civic buildings, churches, stores and historic homes. This pattern is being lost as farms and forests are replaced by suburban residential areas, stores close and move to shopping malls along major traffic corridors, and new municipal buildings are built in outlying areas. The traditional Main Street is rapidly disappearing. Impacts include: loss of community identity, and the introduction of non-traditional architecture including "signature" buildings associated with certain franchises. Maine is beginning to look like every place else.

Loss of Rural Character. Rural areas are defined in large part by two characteristics, one visual and one economic. Visual characteristics include: abundant and sparsely developed forested land; reminders of agricultural times such as working farms, woods roads, and stone walls; and tree lined winding roads that follow the lay of the land. Some visual perception studies suggest that for an area to be thought of as rural, no more than half of the land can be developed for single-family residences and no more than one-third for more intensive purposes. Rural character is also linked with lifestyles that are dependent upon natural resources. There is a productive relationship between the land and the people, farming and forestry for example. In contrast, suburban land is organized for consumption and there is a more passive relationship between the land and the people. In Maine rural areas are being converted into suburban bedroom communities. Farms are being lost to development, roads are being widened and straightened, trees cut down, and unpaved roads paved. Impacts include: loss of traditional resource based industries and cultures, open space, and privacy and freedom.

Loss of Wildlands. Wildlands are large, diverse expanses of undeveloped or sparsely developed land that are not organized for production. Maine's wild places are being lost as a result of forestry activities, development, recreational uses, and changing land ownership patterns. Development fragments the wild areas disturbing natural habitats and interfering with the experience of an untouched Maine. Impacts include: increased tourism, development of previous wild shorelines, and increased noise and light.

A number of factors, when taken together, are seen as the main causes of sprawl. They include:

The automobile: vehicle miles traveled in Maine have increased 60% since 1980.

Traditional zoning has segregated land uses keeping new development from following historic New England village design.

Absence of land use controls in many communities has allowed the development of commercial strips and malls without design controls.

New England economy and population growth: Maine's population increased during the 1970s and 1980s. Population of 9 communities in Southern Maine increased 64% between 1970 and 1985 (see Terrestrial Ecosystems).

Difficulties facing natural resource industries. a decline in fishing, farming and forest related industries along with population pressure and taxes have caused prime agricultural land, forest land, and waterfront property to be sold for development.

New logging roads. 11,000 miles of new roads since the mid 1970s, have opened up remote areas for recreational uses and provided access to previously undeveloped lake shores.

Rising property taxes. in part the result of sprawl, further increase sprawl because they are an incentive to sell of land for development.

The pattern of decentralization is expected to continue and the demand for seasonal housing is expected to continue to increase. A growth of 2,900 to 3,450 new year-round and seasonal units is projected for the LURC jurisdiction during the 1990s.

Quality of Life Criteria. The impact of "sprawl" development on quality of life is of high concern. Impacts include:

Aesthetics. The visual and noise impacts effect everyone and are judged to be high.

Peace of Mind. Medium impact. Sprawl contributes to traffic congestion, deterioration of buildings, higher property taxes and transportation costs, all of which can negatively affect peace of mind. Researchers have found a relationship between open and green spaces and human health. People are very adaptable and can adjust over time.

Recreation. Medium impact. Loss of open spaces in some areas near population centers decreases recreational opportunities. Increased access to wilderness areas increases opportunities for some, but the nature of the experience is changed.

Fairness. Medium impact. Social segregation caused by sprawl imposes the greatest costs on the poor. Poor Maine children grow up in communities with fewer opportunities and resources. The visual degradation affects all groups.

Sense of Community. High impact. People live in more isolated settings as a result of sprawl. They are less likely to live in the towns where they work.

Maine Character. High impact. Visual appearance, natural landscapes, views, architecture, contribute to one's identity; they are symbolic of the land and the people. The loss of healthy neighborhoods, working waterfronts, historic downtowns, century-old farms, and wilderness experiences impact our sense of who we are.

Future Generations. High impact. Loss of open space, wilderness areas, historic architecture is not recoverable.

Economics. High negative impact. Sprawl has some positive benefits. It has benefited the construction industry. Home ownership has also increased. However, it has raised the cost of municipal services and roads and thus property taxes. It may also have a negative impact on tourism, undermining the foundation of Maine's second largest industry.

There are no reports on Ecological or Human Health issues.

Terrestrial Ecosystems

This topic provides an overview of biodiversity in Maine and the possible effects of development and forest practices on that biodiversity. It also discusses the value of forest resources to Maine's way of life.

Ecological Report

Ecosystems are groups of plants and animals that interact with one another and with a common environment. Ecosystems can be defined in different ways and at different geographic scales. The spruce-fir forest of Maine is one example of an ecosystem. Biodiversity is the word used to describe the great variety of life in all of its forms from genes within cells to species to ecosystems.

Located on the southern edge of colder zones and on the northern extreme of warmer zones, Maine serves as a meeting ground of terrestrial communities. While Maine has very few species that are found only in this state, it does have a wide variety of species found in its vast forest, lakes, rivers, alpine and coastal zones. Through the identification of common structures and functions, Maine's terrestrial landscape has been classified into 100 communities.

Eighteen of these communities are considered rare. Rare ecosystems are of concern because they often provide habitat for rare species, including some that may not have been formally identified as of yet. However, not just rare ecosystems require attention. Common ecosystems are subject to alterations that can decrease or change species diversity, cause the loss of genetic diversity, and degrade natural processes and functions. There is also concern over the potential loss of native ecosystems which can serve as reference points for scientific studies.

Ecosystems are changed both by natural (fires, pest outbreaks, blowdowns) and human forces. These disturbances may decrease the number of species, change relative abundance of species, and change species composition. These can affect the recovery, adaptability, function and value of the ecosystem.

The most extreme human-caused disturbances are direct, species-specific exploitation through persecution (the gray wolf, eastern cougar, timber rattlesnake) and over-harvesting (passenger pigeon, great auk, Atlantic white cedar). Today, restrictions against direct exploitation are, for the most part, in place.

Three major classes of activities threaten the health of Maine's terrestrial communities and ecosystems:

Development. Development harms ecosystems through outright destruction of habitat (paving and construction of buildings), habitat fragmentation (breaking up of large land areas thus reducing total habitat area, changing the character of the remaining community, and creating parcels unable to support certain populations) and habitat degradation (decrease in quality). Development and open space fragmentation is of concern in all areas of southern Maine, along riparian zones (the area adjacent to water bodies), and in high altitude areas throughout the state. Fragmentation in southern Maine threatens wildlife that need large forested areas. It may also contribute to the decline of songbirds. Development of shoreline areas throughout the state destroys important habitat for birds, mammals and other wildlife. The level of concern is high for the organized areas of the state and for shorelines and mountain tops throughout the state.

Forest Practices. Because forest communities so dominant Maine's landscape, forest practices including harvesting, herbicide use and road building will influence the health and composition of forested ecosystems. An impact from repeated and intensive forest management is a simplified and fragmented forest containing less complex structures and functions; fewer tree species; conversion to single age class stands; and disruption of normal aging, decomposition and soil processes within tree stands

Clearcutting was a widespread practice in Maine for 20 years. Acreage cut has decreased from 100,000 to 150,000 acres per year before 1989 to about 50,000 acres in 1993. Herbicides are used in Maine's forests

to kill unwanted plants. Forest operations currently account for about 11% of the pesticide use in Maine (based upon amount of active ingredient). Glyphosate, the most commonly used herbicide, has a relatively low toxicity. Herbicides are applied to a given stand about once every 60 years.

There is not agreement regarding the impact of forest practices on wildlife. Some contend that current forest management has resulted in loss of important wildlife habitat and wildlife diversity. Others, however, argue that most of Maine's high profile wildlife are generalists that can find suitable habitat in much of the commercial forest. While many wildlife species depend on early successional habitats, none are found only in old growth forests. In general, information about the effects of forest management practices on biodiversity is poor.

Chemical Pollution. Pollution can damage individual species as well as destroy and alter ecosystems. See discussions on Outdoor Air, Surface Water and Sediments, Land and Agricultural Resources, and Solid, Special and Hazardous Wastes.

Quality of Life Report

This section discusses five contemporary issues related to managing and using forest resources in Maine and their impacts on Mainers' quality of life.

Background. Maine is more forested (89%) than any other state, and more of Maine's forested land (96%) is privately owned than any other state. No other state has as many acres of timberland in industrial ownership.

Reductions in the Area of Forest Cover. It is estimated that Maine's original forest cover was 18,560,000 acres or 94% of the total land area. By 1860, clearing for agricultural purposes reduced that figure to 66%. In 1992, 89% of Maine's land area was again covered with forest due primarily to re-forestation of abandoned farmland.

Both natural events and human actions can reduce forest cover. Natural events seldom result in complete elimination of forest cover. Most long lasting reductions are caused by people converting forest land to non-forest uses.

Removal of forest cover is usually a means to other ends, which in themselves have value, such as agriculture, housing, ski trails and scenic vistas. The "problem" then, is largely one of resolving conflicting goals for land use. The ability of a forest to recover varies greatly, from a relatively short time for a timber harvest to a relatively long time for urban development.

A study of land transactions and land use conversions from 1980 to 1991 involving parcels of 500 acres or more indicates that 91% (5.9 million acres) of the land changing hands was purchased for "timber investment." Another study found that between 1971 and 1991 about 200,000 acres of Maine forest land was subdivided from larger ownerships into smaller lots. About 97% was subdivided through unregulated or "exempt" lot provisions of Maine law. Most of this land will probably remain in forest cover but will be removed from commercial timber production.

Physical Disturbances of Forests. Forests can be physically disturbed by both natural events and human activity involving agents such as air pollution, drought, climatic temperature changes, diseases, insects, fire, windthrow, and harvesting. Physical disturbances affect forest health, attractiveness, condition of soils, wildlife habitat, and the contribution of the forest to air and water quality.

Maine forests suffer little from drought and windstorm. A climatic temperature change of a few degrees could significantly alter the species composition, decreasing the size of Maine's spruce-fir forests. Air pollution can reduce the resistance of some tree species to drought and to insects and diseases. Insects and diseases periodically reach epidemic levels and can have severe impacts. Forest fires are rather effectively controlled but can expose soil to temperature extremes and destroy valuable timber and other personal property. Direct physical damage to tree stems, roots and forest soils is common under some harvesting practices.

Forest practices such as clearcutting can mar the beauty of the landscape. Maine's "Forest Practices Act" has, technically, eliminated very large clear cuts. However, large areas can still be heavily cut to the point they look like clearcuts. "Best Management Practices" minimize soil erosion due to forest operations but are generally voluntary with compliance rates of 70-85%. Physical disturbances of forests can also disrupt critical wildlife habitat.

Reduction of Public Access to Forests. Maine tradition provides largely unrestricted access to forest land without charge, for hunting, fishing, and non-consumptive recreational uses such as hiking and camping. However, there is no guarantee that such access will continue. Restrictions have been caused by posting of land by new owners who are unfamiliar

with the tradition of public access, a wish for privacy, a reaction to litter and property damage, and fear of liability for injury. The severity of current restrictions is low, but the level of concern over an uncertain future is growing.

Any restriction to traditional free public access is viewed as a problem. There is, moreover, a growing realization that tradition is no guarantee of future rights. Alternatives such as public purchase of forest lands offer their own negative impacts ranging from public money not available for other uses to potential restrictions of other forest resource values and uses.

The past twenty years has seen significant increases in the area of public land that is managed for primitive recreation. Maine's public lands now total about 969,000 acres. There is probably less concern in Maine that public access will be lost absolutely than that fees may be imposed where access has traditionally been without charge.

Private Property Rights Issues. There are four basic causes of the private forest property rights issues: a misperception by private property owners of the extent of their rights; tax policies that encourage the destruction of forest properties; inappropriate use of state authority; and resentment of public support programs by landowners who would rather practice responsible forest land stewardship by themselves.

During the past ten years, a strong private property rights movement has arisen in the United States to challenge certain environmental and land use regulations. Private property rights issues, particularly the taking issue, dominate current debates over many quality of life issues related to forest land.

Environmental Impacts of Timber Shortages. Energy remains the single greatest use of wood worldwide. Wood is a biodegradable, renewable resource, well suited for structural and architectural uses. Reductions in timber supplies lead to wood price increases. Price increases cause a shift to nonrenewable fuels for energy and nonrenewable materials for construction.

Price increases for wood products will lead to increased uses of wood substitutes, such as metals, plastics, and cement products. Production of these materials often impacts air and water quality, and uses more energy than comparable wood products.

Timber prices change over time for two basic reasons: 1) changes in demands for timber relative to supply; and 2) changes in the purchasing power of currency. There is evidence of an increasing shortage of timber in Maine, relative to globally changing supply and demand forces for wood-based products.

Quality of life criteria include:

Aesthetics. Medium-high impact. Major disturbances of forests usually have a high negative impact on their aesthetic appeal that are somewhat reduced by the rather rapid re-growth of vegetation.

Peace of Mind. Medium-high impact. Anxiety comes from reductions in forest cover, concern about the disruption of the "natural order" and anxiety over loss of access.

Recreation. Medium impact. Forest-based recreation is important to Maine's quality of life. Disturbances and reduced forest cover can affect recreational opportunities.

Fairness. Medium-high impact. Mainers feel it is unfair to be denied access, while forest landowners carry liability for careless public. Forest landowners feel unfairly taxed, regulated and judged.

Sense of Community. High impact. Long-term changes in quality and quantity of forest resources can change the feel of a community positively and negatively.

Maine Character. High impact. Long-term loss of forest land, human disturbances, reduced access will affect Maine's character, perception of wild and free territory.

Future Generations. Medium-high impact. Loss of access and private property rights have high impact on future generations and opportunities. Loss of cover and disturbances are temporary.

Economics Positive. Medium. A certain amount of disturbance of forests is necessary for timber management. The harvesting of forest resources is an important part of Maine's economy.

Economics Negative. Medium. Long-term loss of forest cover due to physical disturbance would indicate a decline in the health of the forest resource. Reduced access and a decline in forest health would significantly effect forest-based tourism and employment.

There is no report on Human Health issues.

Freshwater and Marine Ecosystems

This topic discusses risks posed by physical and chemical changes to the structure and function of Maine's freshwater and marine ecosystems.

Ecological Report

All ecosystems are constantly changing. As a result, while one may observe a change, the cause and the importance of that change can be difficult to determine. Evaluating the seriousness of potential threats to freshwater and marine ecosystems would ideally take place with a complete understanding of impacts on the structure (types and number of species, sizes of populations, kinds of habitat) and function (productivity, nutrient cycling, energy transfer and metabolic processes). Unfortunately, assessments must be made with limited information.

Wetlands. Maine contains many wetland systems all of which have in common the presence of surface or ground water, water-soaked soils at some time during the growing season, and plants adapted to wet conditions. Wetlands lessen the effects of flooding and are important for ground water recharge, shoreline erosion control, pollution reduction, sediment trapping, and food and wood production. Wetlands are estimated to cover more than 5 million acres (about 25% of the state). Inland wetlands account for 98%, and coastal account for the remaining 2%. Historic wetlands loss in Maine is estimated at between 2 and 20%.

State law regulates activities on wetlands over 10 acres. Most of the applications effecting these wetlands seek permission to fill or alter for road construction and commercial or residential development. Based upon DEP information, between 1990 and 1993 about 75% of licensed wetland fill activities took place in wet meadows and forested wetlands decreasing wildlife habitat, flood protection and the ability of wetlands to trap pollutants. Most of the alterations (80%) took place in coastal wetlands, harming aquatic habitat and the ability to trap pollutants.

Wetlands under 10 acres, except as defined as significant wildlife habitat, are not protected under state law. These wetlands, while small in terms of total acreage are very common. They serve important ecological functions which are at risk of being lost. They are important to the movement of amphibians, reptiles and small mammals and provide habitat for some threatened and endangered species. The level of concern is high for wetlands not regulated by the state; low to medium for regulated wetlands.

Lakes. Maine's 5,785 lakes larger than one acre cover 987,200 acres or about 4.6% of the state's surface area. Of the 2,314 lakes that have been monitored for water quality, 238 are identified as impaired because of algal blooms, loss of dissolved oxygen or causes such as water drawdown. Land use changes around 304 lakes are expected to decrease water quality over the next 20 to 50 years. The primary activity of concern is development. Development causes lake eutrophication, destroys shoreline and aquatic habitat, and increases sedimentation. Lakes receive pollution from activities throughout their watersheds. Nutrients are a special concern. Shoreline changes also increase nonpoint source pollution entering lakes from runoff. Pollution is a serious concern because natural cleansing is slow due to low flushing rates.

Recreational activities such as boating can threaten wildlife populations by disrupting the nesting of ducks, loons, eagles and the spawning of fish. Overfishing is also becoming a concern on some Maine lakes. The possible introduction of non-native plants and animals such as Eurasian watermilfoil and zebra mussels is a growing concern. Recent uncontrolled fish introductions of northern pike, muskellunge, black crappie, and several minnow species have changed fish communities in a number of Maine lakes. Water level changes can cause shoreline erosion and affect nutrient levels, water temperature and fish spawning.

Rivers. Of Maine's 19 major rivers, those (or those segments) lying in the less settled areas generally have high water quality. Rivers (or segments of

rivers) flowing through urbanized and industrialized areas have been impacted by pollutants, and there are stretches characterized by low oxygen and the presence of toxic chemicals. Historically, Maine's rivers and streams were home to large populations of fish that move between fresh and salt waters. These included Atlantic salmon, striped bass, shad, alewives, and sturgeon. These runs have been eliminated or reduced by overharvesting, water pollution and dam construction.

Currently, Maine's rivers are most at risk from habitat destruction and nonpoint source pollution associated with development. Headwater streams are a special concern because they provide fish spawning and nursery areas and naturally cool habitat. Development, agricultural practices and forestry operations that increase erosion and sedimentation, destroy plant buffer strips and change water temperature can change or harm these important areas. Other threats to riverine habitats include the introduction of non-native plants and animals and recreational pressures.

Estuaries and Marine Waters. Maine has 5,500 miles of coastline and 1,633 square miles of estuaries (where freshwater rivers mix with marine waters). Estuarine waters merge into the Gulf of Maine, a semi-enclosed sea covering 35,000 miles. The Gulf supports an abundance and diversity of wildlife, including fish, shellfish, marine mammal and birds. Insufficient data hampers the ability to fully assess environmental trends. However, some serious threats have been identified.

Excessive sedimentation at upland streams and brooks (many of which are important spawning and nursery areas for anadromous species of fish) can clog the flow of water into estuaries and marine waters, bury near-shore habitats, smothering bottom dwelling organisms, and cause a decline in productivity of phytoplankton, macro algae and submerged aquatic plants.

Dredging keeps harbors and anchorages open but also releases sediments and associated chemicals into the water column, making them available for uptake by organisms. A second effect occurs when disposing of the dredged materials. Maine's three designated and monitored offshore disposal sites are not easily accessible to the entire coast. As a result, spoils are disposed of at non-designated sites where impacts are not monitored but likely include increased turbidity, spreading of pollution, and physical alteration of the sea floor.

Overfishing has been identified as the primary cause behind the collapse of the groundfisheries. Maine's groundfish (cod, haddock, hake, flounder, halibut, and others) landings dropped 40% between 1982 and 1993. Recent assessments of lobster indicate that this resource is also overfished. Clam stocks have fallen 67% statewide since 1982. They have fallen 84% in Washington and Hancock Counties. The green sea urchin is being heavily harvested and there is concern for overharvesting and habitat destruction. Of all fish harvesting methods, dragging because it can disrupt the surface of the ocean floor to a depth of 12 inches, may seriously harm populations of bottom dwelling species.

The damming of Maine's rives over the last 200 years had an enormous impact on fish such as Atlantic salmon, cutting them off from their spawning grounds.

Quality of Life Report

This section discusses the ways in which damage to Maine's freshwater and marine ecosystems effects our everyday lives. These effects are cultural, visual and economic. Aquatic ecosystems provide a way of life to Maine fisherman, their families and communities. Commercial and recreational fishing provides employment and income to many Maine families and businesses. If commercial fishing collapses, many small towns will lose their economic base and their distinctive character.

Commercial Marine Fisheries. While the total economic value of fisheries may be low compared to other industries in Maine, it is concentrated in small harbors and villages all up and down the coast. The U.S. Army Corps of Engineers estimates commercial fishing contributed $1.1 billion to Maine's economy in 1992. In 1994, 14,305 commercial licenses were issued to individuals and crews, with about 16,991 people employed at least part-time in fishing.

Maine's commercial fisheries are threatened by:

- Habitat alteration through pollution or development next to essential habitat.
- Over-harvesting of commercial species so that populations are no longer at sustainable levels.
- Water quality problems such as fecal coliform, dioxin, toxic contamination and heavy metals that harm the resource or that make it unsafe for people to eat some fish.

- Land values make it difficult for the commercial fishing industry to keep waterfront property.

Groundfish landings have dropped sharply. Lobster landings are high but scientists feel they are over-exploited. Sea urchins have supported a new and growing fishery but harvest levels will probably stabilize. Aquaculture offers new opportunities for a sustainable fishery, although it creates conflicts with traditional fisheries. Soft-shell clam landings have fallen more than 60% statewide since 1982.

Recreational Fisheries. Recreational fishing is an important Maine pastime. Fishing ranked third in terms of Maine resident user days for recreation behind walking and running for pleasure or exercise. The combined value of inland and marine recreational fishing is between $436.1 and $769.7 million with close to 5000 people employed.

Fishing pressure in inland areas has increased significantly in the past decade with the most dramatic increase in ice fishing. Several of the more popular fish species are over exploited including salmon, trout, small-mouth and large-mouth bass. Exotic species are being introduced into Maine's waters upsetting the balance and health of the ecosystem.

Other Activities. Other activities such as water sports and wildlife-related activities (including hunting, trapping, and photography) depend on clean and healthy ecosystems. It is not inviting to take a boat trip through an algae-choked lake or swim in murky waters. The total economic value for select wildlife-related activities in Maine in 1988 was estimated to be at least $675.7 million.

Quality of life criteria include:

Aesthetics. Medium impact. The loss of commercial fisheries, working waterfronts and traditional fishing villages would negatively impact the distinct character and charm of the Maine coast.

Peace of Mind. High impact. The loss of commercial fisheries would be disruptive for commercial fishing families and communities. Fish consumption advisories on freshwater fish causes uneasiness.

Recreation. High impact. Loss of recreational fishing, wildlife-related activities and water sports would affect a significant number of Maine residents and the state's economy.

Fairness. Medium impact. Fishermen feel they do not have a voice in fisheries management. The transport of toxins and metals from areas outside the state affects Maine fish.

Sense of Community. High impact. Close knit fishing communities would be broken up.

Maine Character. High impact. Independence and versatility of Maine people would be limited. Maritime communities would become more like other places reducing their appeal and charm. The perception of Maine as a clean state is harmed by fish consumption advisories.

Future Generations. High impact. Loss of commercial fisheries means a loss of a way of life for future generations. Loss of traditional recreational activities.

Economics. Any short-term economic gains from over-harvesting and actions that harm aquatic ecosystems are offset by the potential loss of substantial contributions to Maine's economy from commercial and recreational fishing, water sports, and wildlife-related activities that rely on a clean and healthy environment.

There is no report on Human Health issues.

Indoor Air

This topic examines the risks associated with airborne pollutants in homes, office buildings, schools and public buildings. Exposure to toxic chemicals in manufacturing, industrial, agricultural or service industry settings are discussed in Exposure to Toxins in the Work Place.

Human Health Report

Up to 90% of an individual's time is spent indoors in a home or office environment. Indoor air may be polluted by vapors, dusts and gases from building materials, heating and cooling systems, appliances and chemical cleaners, biological organisms, and infiltration of contaminated soil vapors. Many people live and work in buildings where the concentration of air pollutants is higher than in the outdoor air.

Environmental Tobacco Smoke (ETS). Tobacco smoke is a complex mixture of over 4000 separate compounds, many of which are believed to cause cancer. Second hand smoke contains many of the same cancer causing compounds as the inhaled smoke some of which are present at higher levels in the second hand smoke than in the inhaled smoke. Up to 75% of non-smokers are exposed to ETS in typical living environments. ETS is the cause of 3000 lung cancer deaths nationwide each year in non-smokers. It worsens asthma and causes bronchitis and pneumonia. Children of smokers are of special concern. A recent study of children in Portland, Maine who have asthma found that ETS increased asthma attacks and worsened lung function. ETS has also been associated with Sudden Infant Death Syndrome (SIDS). Level of concern is high.

Radon. Radon gas is produced by the decay of radium, a naturally occurring trace element found in rocks and soils. Radon enters basements and ground-level structures where it builds up if the building is not well ventilated. It can also enter a building through the water supply. To date, about 12,000 Maine homes have been tested for radon. About 30% of these (or 3,600) had concentrations of radon greater than the recommended level of 4 picocuries per liter of air. The U.S. Environmental Protection Agency estimates that in 12 of Maine's 16 counties indoor radon levels will exceed the standard. A survey of Maine schools during the 1988-1990 school years found that 98.6% of the buildings had measurable concentrations of radon; 32.2% with one or more classrooms exceeding the standard. The major heath effect is lung cancer. The level of concern is high because large numbers of Maine people are exposed to radon levels that greatly exceed the recommended standard.

Combustion By-Products. All Maine residents are exposed to combustion by-products such as chemicals from tobacco and wood smoke and chemicals from the burning of heating fuels including aldehydes, carbon monoxide, carbon dioxide, nitrogen and sulfur dioxides and particulate matter. Occupants of temporary classrooms, mobile homes, and air "tight" homes are of particular concern. It is estimated that 27% of the houses (homes of about 330,000 individuals) in Maine may have inadequate ventilation. In addition, 85% of the temporary classrooms in Maine have exposed children to carbon dioxide levels which exceed health standards. Possible health effects include death from carbon monoxide poisoning, lung damage and promotion of cancer. The level of concern is high.

Pollutants from Building Materials. Many building materials contain chemicals which are released into indoor air. These include formaldehyde in plywood and particle board, glues, foam insulation, carpet and fabric treatments, and phenols in wood preservatives and finishes. Mercury and lead may be present in the paint in older homes. All of these chemicals can produce serious health effects including cancer from asbestos and formaldehyde and brain and nervous system damage from lead and mercury. Lead poisoning is a special concern for children because it can lower intelligence and cause learning and behavioral problems. A large number of Maine children are at risk for lead poisoning since 80-85% of the housing was constructed prior to 1960 when concentrations of lead in paint were high, up to 50% lead in some paints. Level of concern is moderate overall, but high for lead.

Biological Allergens. Allergens include substances such as pollen; spores; dust mites; and animal dander, hair and feathers. About 20% of the U.S. population

is believed to be affected by airborne allergens. Assuming Maine residents are no different than the general U.S. population, about 250,000 Maine people would be affected. The health effects which include eye irritation, congestion, coughing, and asthma can be debilitating especially for asthmatics. There are about 22,000 children in Maine with asthma, the number of adults with asthma is not known. The level of concern is medium.

Pollutants from Household Products. Everyday items such as dry-cleaned clothes, household cleansers, office equipment, air cleaners, pesticides, solvents and waxes contribute to indoor air pollution. Although these products are considered safe when use properly, they do contain chemicals. Most of these chemicals are irritants, some can cause asthma, some cause cancer, and others may affect organ function. The entire population of the state is exposed to some level of these contaminants, although children are at greater risk. The level of concern is rated low.

Quality of Life Report

The overall level of concern for quality of life impacts from indoor air pollution is medium because of equity issues, concern for the health of children, and the negative economic impacts.

Quality of life criteria include:

Aesthetics. Except for environmental tobacco smoke, indoor air pollution is often not obvious. Impact is low, except for ETS which is high.

Peace of Mind. Medium impact. ETS was unquestionably of high concern before the passage of laws that restrict smoking in certain locations. There is some indication that Maine people are concerned about poor air quality in schools, particularly mobile classrooms and old buildings.

Recreation. This criteria is generally not applicable. There is some evidence that people continue to avoid certain activities and locations where smoking is common, but the issue has been largely addressed.

Fairness. High impact. Smoking creates a fairness issue when a smoker imposes a lung cancer risk on a non-smoker. Fairness issues also exist for other indoor air pollutants. Persons renting property may not be aware of the hazards from substances such as asbestos, lead, formaldehyde, etc. and generally have little or no control over their exposure. Regulations only require the disclosure of such hazards at the time of sale. Additionally, low income persons may be at greater risk due to poor maintenance of properties and poor and improperly vented heating systems. Finally, children are the most vulnerable to the effects of indoor air pollutants and they generally have no knowledge of or control over their exposure.

Sense of Community. Low impact. Indoor air pollution in schools has been a divisive issue in some communities. Exposure to environmental tobacco smoke has been a divisive issue, but the issue has been largely addressed.

Maine Character. Not applicable.

Future Generations. Medium impact. The major concern is for the negative impact on the health of children. Children are at risk for developmental disabilities from lead poisoning and at risk for sudden infant death syndrome, asthma, bronchitis, and pneumonia from environmental tobacco smoke.

Economics Positive. The only direct economic benefits are to those who make money on tobacco and other products which contribute to indoor air pollution.

Economics Negative. Health care costs associated with ETS and other indoor air pollutants are substantial. Asthma, one of the major health effects from indoor air pollution, costs more than $3.6 billion each year in the U.S. in direct medical costs and an additional $2.6 billion in indirect costs such as lost or decreased work productivity. Increases in bronchitis and pneumonia among children less than 18 months of age causes about 7,500 to 15,000 hospitalizations each year in the U.S.

There is no report on Ecological issues.

Exposure to Toxins in the Work Place

This topic provides an overview of occupational illness and disease in Maine.

Background. Occupational exposure to toxic chemicals can be acute or chronic. Acute (short term) exposure results in immediate sickness that can be easily linked to the exposure. Chronic (long term) exposure, which may lead to cancer, reproductive or other long-term health problems, is harder to analyze and document. Almost all information about work related health risks is based on human case histories.

Information about work related illness in Maine is limited. Maine law requires doctors, hospitals and certain other health care providers to report cases of occupational disease to the Department of Human Services. Between March 1986 and June 1993, 683 reports were made; more than half were related to toxics. Toxic gas poisoning, asbestosis, and heavy metal poisoning were the most common.

The Maine Department of Labor's *Occupational Illnesses and Injuries in Maine* report is based upon a survey of businesses. In 1993, repeated injury including tendonitis, carpal tunnel syndrome and hearing loss accounted for 77.2% (3,966 cases) of the reports. Reports of respiratory diseases due to toxic agents increased nearly 32%, from 173 in 1992 to 228 in 1993; dust diseases of the lung nearly 48%, from 23 to 34. Poisoning decreased nearly 71% from 48 to 14.

While these reports are helpful, many cases may not be reported. In addition, many of Maine's self-employed, part-time, agricultural and small business workers may not be included in existing data sources.

Human Health Report

Pesticides. Agriculture accounts for nearly 90% of Maine's pesticide use by active ingredient. The EBDC (ethylene bisdithiocarbamates) fungicides are used in the greatest quantity with 704,882 pounds sold in 1992. Captan was second with 98,989 pounds sold. Acute (short-term) health effects associated with these fungicides is relatively low. Chronic (long-term) health effects include developmental malformations and cancer. Captan causes developmental problems, cancer, and affects the ability of the body to fight disease. Pesticide applicators, farm workers, and nearby residents affected by airborne drift are most at risk. Among these, migrant workers, children of farm families, and pregnant women and their developing babies are of special concern.

A 1990 study of migrant laborers in western New York found that 40% of the children who had been in the fields had actually been sprayed with pesticides. Studies of farmers in the U.S. have shown an increase in certain kinds of cancer. The Maine Department of Human Services *Occupational Disease Annual Report* for 1994 showed only 2 cases of pesticide poisoning for 1986-1993; however, under-reporting is thought to be widespread. Pesticide use rates are expected to remain fairly constant. In recent years there has been a shift to the use of less persistent, but in some cases more acutely toxic pesticides. Level of concern is medium.

Lead. Occupations where lead hazards exist include: bridge construction, general construction and demolition, secondary lead smelting, ceramics, renovation and reconstruction of old buildings, automobile radiator repair, painting, and shipyard work. Among these workers, pregnant women and women of child-bearing age are of special concern. Lead can be deposited in bone and fetal exposure can occur although the mother may no longer be exposed. In 1994, the Maine Department of Human Services received 104 reports of elevated blood lead levels in workers, 80% of these from the construction industry. The widespread use of lead-based paint prior to the 1970s will continue to pose threats to construction workers for decades. Level of concern is high.

Arsenic. Processes such as copper or lead smelting, wood treatment, glass manufacture, and pesticide manufacture use arsenic. Only one Maine business uses significant amounts of arsenic, making the potential for significant worker exposure in Maine low. Level of concern is low.

Noise. In Maine, workers in the lumber, wood products, and textile industries are at risk (about 118,500 people). Major health problems include hearing loss, hypertension, and possibly psychological disorders. Occupational exposure to noise is the cause of about 1 million cases of hearing loss in the U.S. While the number of persons potentially exposed to harmful levels of noise in Maine is large, exposure can be easily controlled. Level of concern is low.

There are no reports on Ecological or Quality of Life issues.

Solid, Special and Hazardous Waste

This section provides an overview of solid, special and hazardous waste generation in Maine. It examines the negative effects from improper handling or disposal of these wastes including risks associated with improperly sited dumps, unlicensed landfills and uncontrolled hazardous waste sites. It also examines the impacts of past problems on efforts to build new or expand existing facilities.

Background. Before 1970 there was little government control over the storage, handling or disposal of solid, special or hazardous wastes. Many wastes were disposed of in unlined lagoons, leach fields, dumps, or placed directly on the ground in any convenient location. In response to public health and environmental problems, a complex set of laws were developed to control waste handling.

Municipal solid waste is trash generated by households and businesses and includes wastes such as paper, plastic, glass, metal, food wastes and bulky items such as tires and appliances. Maine generated 1.29 million tons in 1993. About 36% was incinerated, 33% recycled, 28% landfilled, and 3% sent out-of-state. About 370 Maine towns have recycling programs. Maine has enough space in existing landfills and incinerators to manage the trash produced. Bulky wastes (tires, appliances, construction debris and furniture) are difficult to recycle and manage.

Special wastes are non-hazardous wastes that require special handling because of their chemical and physical properties. Special wastes include sludge, incinerator ash, asbestos and other industrial by-products. Maine generated 1.9 million tons in 1991. 64% was landfilled, 16% incinerated, 13% landspread, 3% reused or recycled, 3% composted and 1% sent out-of-state. The paper industry is the largest generator (74% of the total). Maine has two commercial facilities that accept special wastes.

Hazardous wastes include contaminated chemicals, chemicals that can no longer be used, certain wastes from industrial processes and wastes that are corrosive, reactive, ignitable, toxic or leach certain pollutants. In 1991, Maine generated about 13,600 tons that were shipped off-site and 10,230 tons that were managed at the facilities where they were generated (including beneficial reuse, neutralization and metals recovery). Wastes not managed on-site are shipped out-of-state to treatment and disposal facilities. Hazardous waste is regulated by the federal and state governments and is tracked from generation to disposal. Maine's Toxics Use and Hazardous Waste Reduction Law requires a 30% reduction in hazardous waste generation by 1998 (from average of 1989 and 1991 figures).

Ecological Report

Little work has been done in Maine on the ecological effects associated with solid, special or hazardous waste sites. A few ecological assessments have been conducted at Superfund sites in Maine. For the most part, these studies have been very limited and only suggest possible concerns. The ecological importance of these individual findings is unknown. Some examples of potential ecological problems that have been found at Maine sites are listed below.

- PCB pollution may have negative impacts on wildlife at a few sites. For example, PCB levels in tadpoles at the O'Connor site reflect levels in soils and sediments indicating that the PCBs are building up in the tissues of tadpoles.

- Mercury pollution may pose a threat to terrestrial organisms at a site on the Brunswick Naval Air Station.

- Discharges of contaminated ground water to land and to surface waters at some sites including Loring Air Force Base and Winthrop Landfill may be having a negative effect on some plants and aquatic (water) organisms.

- An ecological assessment of the Piscataqua River estuary is being conducted. Levels of lead, chromium, nickel, zinc, mercury, and PCBs are among the pollutants being found in water, bottom sediments and the tissues of some shellfish.

There is also some concern over the loss of ground water resources. There are many cases in Maine where waste sites pollute ground water. Many times the major pollutants are heavier than water. They therefore sink through the water column, polluting all ground water they pass through. These chemicals can pollute large amounts of ground water. They are difficult to locate and almost impossible to clean up with current techniques. Once polluted by these chemicals (which are referred to as DNAPLs or dense non-aqueous phase liquids) the ground water is no longer safe to drink. This is happening at sites across the state.

Human Health Report

This report is divided into two sections, one on non-hazardous solid waste landfills and dumps and the other on hazardous substance sites.

Non-Hazardous Solid Waste Landfills and Dumps. Licensed landfills are not discussed. The focus is on the hundreds of old landfills and dumps which are scattered across the state. It is likely that the location of some of these dumps is still unknown. The major concern at these sites is pollution of ground water and surface water. The build up of toxic and explosive gases is also a concern. People with private wells located near old dumps are most at risk. Two of Maine's old town landfills, Winthrop and Saco, are federal Superfund sites. These sites received industrial wastes in addition to municipal solid wastes. As Maine continues to close old landfills and dumps, risks should decrease. Level of concern is low to medium.

Hazardous Substance Sites. RCRA (Resource Conservation and Recovery Act) facilities are businesses, industries, and institutions that generate and handle hazardous wastes. There are about 3000 RCRA facilities in Maine. These sites may have contaminated areas as the result of past chemical spills or waste handling practices. There is also the possibility of spills from current operations especially from the handling of process chemicals (not wastes). Contamination problems at currently operating facilities are generally handled by the existing owner working with the Department of Environmental Protection. Only a small number of currently operating RCRA sites are known to have contaminated the environment at levels which pose a threat to human health.

Contamination associated with abandoned sites or areas where the source of contamination is not known is handled by the DEP's Uncontrolled Hazardous Substance Site Program. Since 1983, more than 400 sites have been reported to the DEP. Of these 76 were not a problem, 106 were referred to other programs, 99 have been resolved, and 134 are being studied or cleaned up. Ten of these sites are Superfund sites, another has been proposed for listing.

Hazardous substance sites present two general types of problems: the potential for direct contact with chemicals or concentrated wastes at the site such as wastes in leaking drums, and problems caused by chemical contamination of the air, land, ground water or surface water. Chlorinated solvents, PCBs, pesticides, and heavy metals such as lead are among the pollutants found at these sites. In addition to exposure through direct contact with wastes, contamination of the soil and ground water are the major human health concerns. Contaminated soils may be accidentally eaten by children (dirty hands) and drinking water wells may be polluted. Pollutants are often present on site at levels much higher than health based standards. On-site workers and persons living in the immediate area of the site are at greatest risk. Under some conditions pollutants can move a considerable distance from the site especially through ground water. Exposure is generally limited by steps taken to restrict access to these sites (for example, fences are put up) and to prevent persons from drinking polluted water (bottled water supplied, public water extended to the area). The actual exposure of persons at or near these sites is not known. The level of concern is high for persons living near uncontrolled sites.

Quality of Life Report

The Quality of Life report examines issues associated with our current waste generation and management practices, old waste sites, and the siting of new facilities.

Waste Generation and Current Management. Maine people and industries continue to generate large quantities of wastes. Managing these wastes to avoid public health and environmental problems costs money. Large generators are subject to strict regulation. Other wastes such as household hazardous wastes and wastes from some small quantity generators may not be managed appropriately. Quality of life impacts include:

Aesthetics. Low impact. Trend toward regionalization has resulted in few sites. Operation and maintenance requirements limit impact.

Peace of Mind. Medium impact. Although management of wastes has improved over the past 20 years, public perception appears to lag behind actual operating practices. In the MEPP survey of environmental concerns, waste disposal was a major concern. Day to day management of wastes does not seem to be an issue for most Maine people.

Recreation. Low impact. There are few waste sites. Illegal disposal of trash and bulky wastes is a problem in rural areas. Maine's 1993 State Comprehensive Outdoor Recreation Plan identified illegal waste dumping on private land as a problem.

Fairness. Medium impact. Regionalization concentrates the impacts in a few communities. Financial benefits to host communities offset some of this impact.

Sense of Community. Low impact. Successful bond issues indicate community support for managing wastes properly. Waste management issues are divisive in some communities.

Maine Character. Not applicable.

Future Generations. High impact. Our current management strategies may produce problems that we are not yet aware of. Illegal disposal may create long-term problems.

Economics positive. High impact. Recycling and waste management create jobs. Avoided costs from properly managed wastes are high.

Economics negative. High impact. Waste generated must be managed. The more generated the greater the cost. Better facilities and management practices cost money. Current municipal solid waste tipping fees range from $28 per ton to $170 per ton with an average cost of $35 to $40 per ton. Special waste disposal costs range from $45 to $75 per ton in a commercial landfill and $35 to $40 per wet ton landspread. Typical hazardous waste disposal costs range from $270 to $420 per 55 gallon drum plus transportation costs. Wastes create long-term liabilities.

Legacy of Past Management Practices. Maine has hundreds of former disposal sites that are sources of pollution. These include more than 400 landfills (46 of which have contaminated sand and gravel aquifers), and 134 uncontrolled hazardous waste sites which are currently being investigated or cleaned up. Many of these problems are the result of practices that were thought to be safe at the time they were used. The full extent of contamination from past practices is not known. These sites are expensive to clean up. Quality of life impacts include:

Aesthetics. Low impact. Many present no obvious hazard. Access is often restricted.

Peace of Mind. High impact. Waste disposal was frequently cited as a major environmental concern in the MEPP survey. Constantly changing ideas about safe levels leads to mistrust and confusion. No guarantees for proposed solutions combined with past errors about safe practices feeds fears.

Recreation. Low impact. Any problems are localized and alternatives are available.

Fairness. High impact. Number of persons directly harmed is low, but the severity of the impact for those individuals is great. Those who are harmed are often not the same people who caused the problem. Exposures are involuntary.

Sense of Community. Low impact. Most poorly managed sites affect small groups of people. Waste sites can unite a community in an effort to address the problem or they can divide it by raising economic, blame and other issues.

Maine Character. Low impact.

Future Generations. Medium impact. Effects decrease over time. Cleanup efforts benefit future generations but costs (repaying bonds) are transferred to future generations.

Economics positive. Low impact. Some people earn money investigating and cleaning up sites.

Economics negative. High impact. All Maine people pay for the high cost of cleanup through bonds and tax dollars. As of 1994, $27 million had been spent on municipal landfill investigations, closure and remediation. Responsible parties have spent millions of dollars on a single Superfund site.

Siting Waste Facilities. Concerns about the problems caused by past waste facilities has made siting new facilities difficult and expensive. The technical complexity of the issues often makes it difficult for the average person to understand and feel comfortable with the information. Mistakes of the past and no guarantees on the future create mistrust. Efforts to site new facilities have been very controversial. Quality of life impacts associated with siting facilities include:

Aesthetics. Low impact. Regulations at least partially control impacts. Few sites.

Peace of Mind. High impact. Siting efforts create high anxiety in a community. Problems associated with other sites both past and present increase mistrust and fear and are not soon forgotten.

Recreation. Not applicable.

Fairness. Medium impact. Persons generally do not seek to locate these facilities in their towns. Communities often feel unfairly singled out. Host community benefits such as reduced tipping fees and reduced property taxes may partly offset the negative impacts.

Sense of Community. Medium impact. Efforts to locate a facility can either bring people together or divide them.

Maine Character. Low impact. Few communities affected.

Future Generations. Medium impact. Waste once produced must be managed. Today's choices reflect today's knowledge. Future generations will live with our decisions, good and bad.

Economics Positive. Low impact. The difficulty of siting produces more work for some sectors of the economy. The business climate is improved if the state's waste management system can support growth and development.

Economics Negative. Medium impact. The difficulty of siting a facility increases costs.

The overall level of concern for waste is high for peace of mind; medium to high for economics negative; medium for fairness and future generations; and low for aesthetics, sense of community, Maine character and economics positive.

Radiation

Background

Types of Radiation. Radiation can be grouped into two distinct classes: ionizing and non-ionizing. Non-ionizing radiation is exclusively electromagnetic waves. Research on the possible impacts of this type of radiation has suggested that occupants of buildings near high voltage transmission lines may be at risk for health effects (specifically cancer), and that children may be more at risk than adults. However, the results of the various studies conducted to date are unclear. The human health group decided that no conclusions should be drawn regarding risks in Maine.

"Ionizing radiation" refers to the release of particles from the center or nucleus of an unstable atom. These particles can break chemical bonds in the cells of living organisms. This is known to cause an increased risk of cancer in humans. Unstable atoms which give off radiation during the process of decay exist both naturally (uranium and radium) and as manufactured products (plutonium).

Units of Measure. Radiation is described in terms of the energy absorbed by a target organism, in "rems" or "millirems". This unit is typically used to express an exposure rate when a time factor is applied, as in millirems per hour, or a dose rate, as in millirems per year. The dose from all sources of ionizing radiation is cumulative (builds up) over an individual's lifetime.

Ecological Report

The ecological working group did not evaluate the issue of radioactive waste generation and management. However, some information was provided by project staff.

Maine Yankee has the potential to impact the environment as a result of its normal operations through releases of fission gases, radioactive iodine, and particulates to the atmosphere and Montsweag Bay. Studies of the possible ecological impacts from Maine Yankee are few and were conducted in the 1970s.

Monitoring of Radioactive Releases. Atmospheric releases from Maine Yankee are regularly monitored within a one mile radius of the plant by the State Environmental Monitoring Network. The maximum annual exposure since 1988 was 0.2 millirem for a person living at the one mile boundary. [The Nuclear Regulatory Commission (NRC) guideline for human exposure from atmospheric emissions is 35 millirems.] The Maine Department of Human Services Division of Health Engineering monitors samples of fresh water, salt water, seaweed, vegetation, milk, fish, sediment, and air for radioactivity. In 1993-94, levels found were below health standards. Ecological effects are undetermined.

Thermal Pollution and Entrapment. The issues of thermal pollution and physical entrapment of aquatic organisms in the water intake structures have been examined at Maine Yankee. In both cases, steps were taken to limit impacts during the first years of plant operation. In 1977 Maine Yankee reported that the increase in temperature due to thermal discharges is less than the normal temperature variation during a tidal cycle. The long-term impact, if any, of heated water entering Montsweag Bay is unknown.

Human Health Report

Natural Sources. Radiation from natural sources is common in the environment. The most important sources of exposure to radiation are natural. Naturally occurring radioactive elements in the earth (uranium and radium) and cosmic and solar radiation annually contribute, on average in the United States, about 100 millirem exposure to the soft tissues of the body. The National Academy of Science (1990) has placed the risk of all cancers at 8 in 100,000 for this level of exposure. This type of exposure can be considered "background level" exposure, since there is very little that can be done to control it.

In addition, naturally occurring radon, a decay product of radium, results in an average U.S. exposure of 2400 millirem to the lining of lung air passages (this equals an indoor air concentration of 1 picocurie/liter (pCi/L)). In Maine, the exposure from natural sources is even higher due to radon-producing rock in many parts of the State. About 30% of Maine homes may have indoor air levels that are greater than

EPA's standard of 4 pCi/L (based on a sampling of 12,000 homes). About 204 schools are also known to exceed this standard. These higher exposures can be limited. Note that the EPA standard is not based on a "safe" level (it actually represents an increased lifetime cancer risk of 2 in 1,000); rather it represents a realistic level given existing sources. Level of concern is high.

Nuclear Power Plant Releases. In contrast to these natural sources, annual exposure due to both gaseous and liquid releases from the Maine Yankee nuclear power plant amounts to less than 1 millirem (estimated maximum annual dose of 0.05 millirems in 1993, maximum since 1988 of 0.2 millirems). A 1 in 5,000,000 lifetime risk would occur for an exposure of about 0.2 millirems. Level of concern is low.

Transport of Low-level Radioactive Waste. Packaging and transportation of radioactive waste are regulated by the U.S. Nuclear Regulatory Commission and the U.S. Department of Transportation. The people exposed to the greatest risk from transportation accidents are the drivers and handlers of the materials. Records on accidents involving this waste showed that there were about 10 accidents per year for the entire country between 1971 and 1980, and in no case was radioactive material released in amounts that would present a public health threat. The maximally exposed individual (driver/handler) theoretically receives about 20 millirems per year from shipment of radioactive material associated with nuclear power; however, there are no specific studies in Maine to validate these estimates.

Exposure from handling and transport of low-level radioactive waste will increase in the future when Maine Yankee is decommissioned. Whether this results in an increased human health risk depends on the adequacy of precautions taken, including the adequacy of training and the readiness of response teams. The current level of concern is low.

Quality of Life Report

This report examines the issues of radioactive waste generation and management and safety at Maine Yankee.

Background. Radioactive waste may be classified as either low-level or high level.

Low-level radioactive waste includes items such as contaminated clothing, gloves, shoe covers, tools and equipment that have been exposed to radiation. In 1992, 49 facilities in Maine generated low-level radioactive waste. Generators included the nuclear power plant, school and medical research facilities and treatment centers, industry and government. Most of this waste is stored on the site where it was produced until radiation levels decrease to background and it can be disposed of as ordinary solid waste. Some low-level waste takes longer to lose their radioactivity and must be stored in a special facility. In 1992, 16 Maine generators produced low-level waste that cannot be handled as solid waste but which must be stored long-term in a nuclear waste repository. The largest of these was Maine Yankee both in terms of amount of waste and the level of radioactivity. Since January 1, 1993 out-of-state low-level waste facilities have been closed to Maine. Maine has entered into an agreement with Texas. Maine wastes will be shipped there once that facility is built.

High-level radioactive waste includes spent nuclear fuel and materials that have come in contact with very high levels of radiation. High -level radioactive waste is generated by Maine Yankee and Portsmouth Naval Shipyard. There are currently no high-level repositories, although one is to be built at Yucca Mountain in Nevada. Maine Yankee presently stores its "spent fuel" (high-level radioactive waste) on-site in what was expected to be a temporary storage pool. By "re-racking" or reconfiguring the spent fuel rods to a greater density it has managed to continue using this pool beyond its intended capacity. This year it will begin another re-racking to provide storage capacity to its closure date of 2008. Upon decommissioning, the high level radioactive waste is scheduled to be moved to the Yucca Mountain Facility.

Radioactive Waste Disposal and Decommissioning of Maine Yankee. Maine currently has a problem in that there are no facilities available to receive radioactive waste generated in Maine. The lack of facilities is a problem for all generators including hospitals, research institutions, and the power industry. This problem will increase if facilities are not available when Maine Yankee is decommissioned. Maine Yankee is licensed to operate until the year 2008.

The lack of disposal facilities is attributed to many factors including: the fact that the waste is dangerous and must be carefully managed, conflicting studies on health effects, distrust of business and government, lack of political leadership, opposition to involuntary risk, and the fear of pollution and potential catastrophes.

Safety at Maine Yankee. Maine Yankee began operations in 1972. By most measures the safety record at Maine Yankee has been good. A 1995 Nuclear Safety Report to the Legislature showed Maine Yankee to have been rated by the NRC as having superior plant operations and emergency preparedness, and good engineering/technical support and maintenance/surveillance. The recent development of cracks in the steam tubes has raised the concern of a potential safety problem, despite assurances by the utility and the state Nuclear Safety Advisor that the repairs being made (fitting new tubes inside the old) is a "proven technology."

Quality of Life Criteria. The overall level of concern was medium. Aesthetics, Recreation and Maine Character were determined to be not applicable.

Peace of Mind. Public anxiety over nuclear waste disposal is high, in part due to the dangerous nature of radioactive waste, the complexity of the issues, and distrust of the nuclear industry and the governmental regulatory agencies. Public concern over the disposal of low-level nuclear wastes has been substantially reduced as a result of the compact signed with the State of Texas to receive Maine's waste at its Hudsputh County facility beginning in 1997. However, the issue of disposal of high-level radioactive waste remains a highly sensitive one. Although safe disposal of these wastes is a federal responsibility, the planned federal storage facility at Yucca Mountain in Nevada (scheduled to open in the year 2010) is the subject of an ongoing controversy as to its safety which recently prompted some members of Congress to move to cut funds for the site. These controversies underscore the political and technical challenges of siting, designing, constructing, and maintaining a structure that must remain secure and undisturbed for centuries.

Given the controversy associated with this facility, concern is raised that the temporary storage will become a permanent storage, with possible impacts on future generations. Other concerns associated with decommissioning relate to expected costs (critics charge the utility has underestimated the decommissioning costs); and potential safety problems in demolishing the reactor containment building, if undertaken, which is only 50 feet from the spent fuel storage facility.

Fairness. Low impact. All Maine people benefit from the generation of nuclear wastes as well as the costs. This is true for both Maine Yankee and medical, research and other uses. This evaluation was limited to Maine effects; the issue of fairness to Texas or Nevada residents was not evaluated.

Sense of Community. Medium impact. Nuclear power generation has deeply divided Maine people. There have been three public referenda. Each time Maine people have voted to keep the plant open; however, a sizable minority wished to close the plant. On the other hand, Maine people have been united in their opposition to the location of either a high-level or low-level repository in Maine.

Future Generations. Low impact if out-of-state facilities are constructed and operate as planned; otherwise, high impact

Economics Positive. Medium. There are economic benefits from the products of research and medical treatment. Maine Yankee has been a relatively inexpensive source of power and a significant source of revenue for the Town of Wiscasset (90% property tax revenue).

Economics Negative. Medium impact. The cost of decommissioning Maine Yankee will be high. Maine Yankee estimates the cost at about $350 million in 1993 dollars. Critics estimate the cost at $2 to 3 billion. Current power costs include some money set aside for decommissioning.

Terms and Abbreviations

CFCs: Chlorofluorocarbons, a group of chemicals that deplete the protective ozone layer.

CSO: Combined sewer overflow. A pipe that discharges untreated sewage and storm water during storms when the capacity of the wastewater treatment plant cannot handle the increased load.

DEP: Maine Department of Environmental Protection

DHS: Maine Department of Human Services

DNAPLS: Dense non-aqueous phase liquids. A term used to refer to chlorinated solvents that are heavier than water and that sink through aquifers contaminating ground water.

EPA: United States Environmental Protection Agency

ETS: environmental tobacco smoke

HAPs: Hazardous air pollutants also known as air toxics, include hundreds of chemicals used in industrial societies.

MTBE: A gasoline additive commonly found in ground water near underground storage tanks.

PCBs: Polychlorinated biphenyls. A group of manufactured chemicals widely used in electrical equipment. Manufacture was banned in the U.S. in the late 1970s, but some are still in use. They are suspected of causing cancer.

THMs: Trihalomethanes. A group of compounds produced when chlorine interacts with natural organic acids such as those produced when leaves decay. A relatively common contaminant of chlorinated drinking water.

Working Group Members

Ecological Technical Working Group

Michael Cline, Maine Audubon Society
Robert Cope, Champion International Co.
David Courtemanch, Dept. of Environmental Protection
Gary Donovan, Dept. of Inland Fisheries and Wildlife
Franklin Eggert, Univ. of Maine/Horticulture (retired)
Ivan Fernandez, University of Maine/Forest Resources
Anne Hayden, Private Consultant, Brunswick, Maine
Jeffrey Kahl, Univ. of Maine/Watershed Geochemistry
Joseph Kelley, Maine Geological Survey
Richard Langton, Department of Marine Resources
Paul Leeper, Eco-Analysts, Inc.
Carolyn Lepage, Robert G. Gerber, Inc.
John Lortie, Woodlot Alternatives, Inc.
Donald Mairs, Dept. of Ag., Food and Rural Resources
Janet McMahon, The Nature Conservancy, ME Chapter
Thomas Saviello, International Paper Co.
John Sowles, Department of Environmental Protection
Edward Spear, Great Northern Paper, Inc.
Barbara St. John Vickery, The Nature Conservancy, Maine Chapter
Robert Steneck, Univ. of Maine, Darling Marine Center
Ken Warner, Dept. of Inland Fisheries and Wildlife
Ellen Baum, Facilitator
Elizabeth Brown, Nick Houtman, and Mark Sullivan, Writers

Human Health Technical Working Group

Gregory Bogdan, Department of Human Services
Rodney Bushway, University of Maine
Richard Doherty, M.D., Foundation for Blood Research
Philip Haines, Health and Environmental Testing Laboratory, Department of Human Services
Edward Hayes, M.D., Department of Human Services
Lebelle Hicks, Dept. of Agri., Food & Rural Resources
Bruce Hunter, Department of Environmental Protection
Donald Magioncalda, M.D., Kenn. Valley Med. Cntr.
Lisa Miller, Private Consultant, Health Behavior/Health Education
Beverly Paigen, The Jackson Laboratory
Gary Patzlaff, Bath Iron Works
Ellen Parr Doering, Dept. of Environmental Protection
Marvin Schneiderman, National Research Council
James Smith, formerly with ChemRisk
Brian Stetson, Great Northern Paper Co.
Peter Washburn, Natural Resources Council of Maine
Deborah Deatrick, Facilitator
Kathy Sage, Writer

Quality of Life Technical Working Group

Ron Beard, University of Maine
Fred Beck, F.M. Beck, Inc.
Brian Beal, University of Maine
Tom Cieslinski, Department of Conversation
Steve Evans, Maine Yankee
David Field, University of Maine
Marion Harris, Pine Tree Legal Assistance, Inc.
Mary Ann Hayes, Maine Association of Planners
Tom Howard, Georgia-Pacific Corp.
Jolan Ippolito, Sunday River Ski Resort
Denise Lord, Maine Waste Management Agency
Fran Rudoff, Department of Economic and Community Development
Mary Smith, Central Maine Power
Stewart Smith, University of Maine
William Stone, University of Maine
J.R. Vitelli, Ret. Professor, English and American Civilization
Gro Flatebo, Facilitator
Gro Flatebo and Frank O'Hara, Writers

Other Contributors

Harold Borns, University of Maine
Stanley Chenowoth, Department of Marine Resources
Ted Creaser, Department of Marine Resources
Stephen Dickson, Maine Geological Survey, Department of Conservation
Florence Grosvenor, Dept. of Environmental Protection
Nick Houtman, University of Maine
Michael Kelly, Advanced Management Catalyst, Inc.
Phil Kemp, Assistant State Toxicologist, Department of Human Services
Jay Krouse, Department of Marine Resources
Stephanie Martin, College of the Atlantic
Ann Melville, Department of Environmental Protection
Gary Nielsen, Private Consultant
Melissa Perera, University of Maine Graduate Student
David Stevenson, Department of Marine Resources
Beth Thomas, College of the Atlantic
David Vail, Bowdoin College
David Wright, Department of Environmental Protection

Project Staff

Cynthia Bertocci, Project Administrator, Department of Environmental Protection
Karl Wilkins, Department of Environmental Protection

Maine Environmental Priorities Project
State House Station #17
Augusta, Maine 04333-0017